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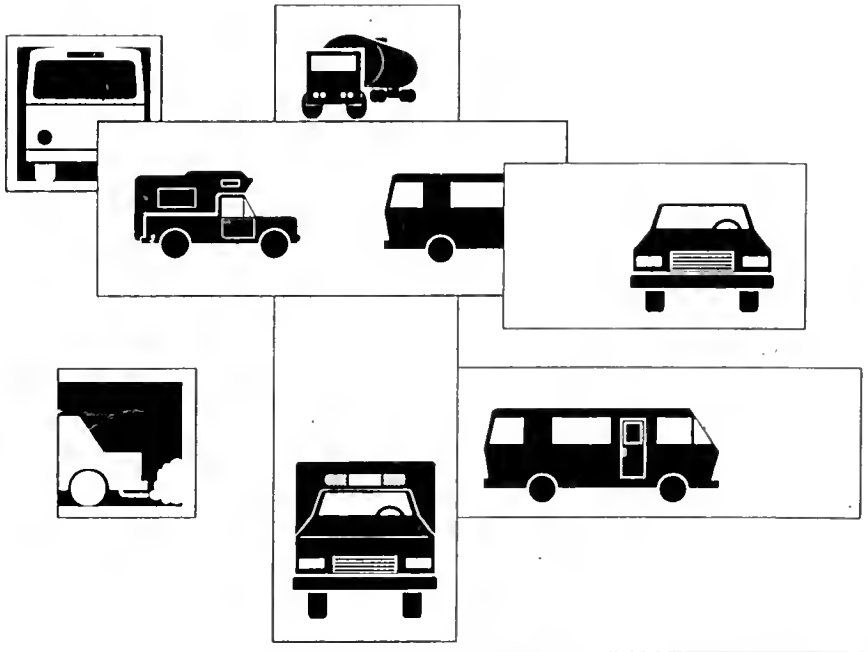
RESOURCE CONSERVATION

# *GUIDE TO* Resource Conservation and Cost Savings Opportunities in the Automotive Parts Manufacturing Sector



Ministry of the Environment

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# Guide to Resource Conservation and Cost Savings Opportunities in the Automotive Parts Manufacturing Sector

March 1998

Prepared for:

Industry Conservation Branch
Ministry of the Environment

by:

Proctor & Redfern Limited

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We wish to acknowledge the work and effort of the following organizations and private firms in providing valuable information, technical input and comments throughout the development of the guide. We are grateful to the members of the Steering Committee who have made themselves available throughout the project:

- Peter Corbyn, APMA
- Michael Dube, Ministry of Economic Development, Trade and Tourism (MEDTT)
- Nick Markettos, Bob Walterson, John Rinella, Bruce Gillies, Ministry of the Environment (MOE)

The Steering Committee also wishes to thank Katherine Taylor and Greg Rooney, Proctor & Redfern Limited for their skills and effort in preparing this document.

**Dear Reader:**

The Ontario Ministry of Environment and Energy (MOEE) and the Automotive Parts Manufacturers' Association (APMA) are pleased to provide this copy of the "Guide to Resource Conservation and Cost Savings Opportunities in the Automotive Parts Manufacturing Sector". The guide was prepared jointly by the Ministry and APMA.

This guide identifies and promotes opportunities for conserving energy and water, as well as reducing waste, in the automotive parts manufacturing sector. By taking advantage of these opportunities, operators can lower their costs while conserving valuable resources.

Many groups have an interest in further improving environmental performance, including owners, managers and employees, entrepreneurs, product and technology suppliers, engineering designers, and consultants. By combining their own knowledge and skills with the information contained in this guide, these groups can help keep the Ontario automotive parts manufacturing sector competitive by becoming more efficient and by conserving valuable resources.

We hope this guide is useful to you and your company. We would be grateful to receive any comments or questions you may have about this publication. A form is enclosed so that you can send comments by fax or mail.

You may also contact APMA by fax (416) 620-9730 or e-mail (apma@interware.net). The Industry Conservation Branch of the MOEE can be reached by fax at (416) 327-1261 (to the attention of Ana Rosati) or e-mail (rosatian@ene.gov.on.ca).

Daniel Cayen, Director
Industry Conservation Branch
Ministry of Environment and Energy

Peter Corbyn, Director
Environment
Automotive Parts Manufacturers' Association

# EXECUTIVE SUMMARY

## PURPOSE

This "Guide to Resource Conservation and Cost Savings Opportunities in the Automotive Parts Manufacturing Sector" was prepared to help those involved in manufacturing automotive parts to identify potential process improvements that will reduce production costs, conserve resources and prevent pollution. It is intended to be a helpful tool that can be used in combination with existing skills and knowledge among clients who share an interest in the sector. The Guide is directed primarily to company owners, managers and employees. Other individuals and client groups who would be interested in this Guide include product and technology suppliers, engineering designers, consultants and related associations.

The Guide offers generic process descriptions and checklists of improvement opportunities specific to the major steps used in the production of automotive parts. Not all companies in Ontario's automotive parts sector include all the steps in their process that are described in the Guide. In addition, each facility has its own configuration that makes it unique. However, any company that manufactures automotive parts may find sections of this guide helpful in identifying ways to conserve energy and water, and reduce wastes and costs.

## HIGHLIGHTS

Using Section 6, readers can review conservation opportunities that may offer savings for automotive parts manufacturing facilities. Some opportunities can be implemented immediately and/or at low or no cost. Other opportunities will require more detailed analysis for specific facilities to evaluate potential savings. The following provides highlights of the conservation measures that are included in the guide.

### Energy Conservation

- Methods to improve boiler system efficiency including reducing steam losses, fuel conversion, cogeneration, insulation, and reducing blowdown.

- A worksheet to calculate the cost of compressed air leaks and identification of ways to identify and repair leaks.

### Water Conservation

- Measures to reduce water usage by sanitary fixtures are listed, including water efficient shower heads, tap aerators and low volume toilets.

- Typically cooling towers and parts cleaning are the two largest process water consumers. Methods to reduce water usage in these areas are discussed.

### Chemical Management

- Environmentally friendly products are currently available to substitute for many materials. The guide provides a number of alternates as well as identifies sources that may be used in order to assist in material substitution.

### Wastewater Management

- The guide provides a discussion of currently available wastewater treatment methods and their applicability to various process streams.

### VOC Emission Reduction

- Methods to reduces VOC emissions from painting are identified including increasing transfer efficiency, conversion to water-borne paints, conversion to high concentration solids coatings, and many others. Reduction in solvent usage for cleaning is also addressed.

### Waste Reduction

- The guide provides information on how to determine what is being disposed of and the disposal costs. Waste reduction opportunities include recycling corrugated cardboard, replacing of wood pallets with other permanent pallets, returning drums, recycling office paper, and working with suppliers to reduce packaging.

### Environmental Management

- The essential elements of an ISO 14001 environment systems are discussed including identifying environmental aspects and establishing measurable targets.

- A number of government programs relating to environmental management including the Pollution Prevention Pledge Program (P4)and the Voluntary Challenge and Registry Program (VCR) are highlighted.

## STRUCTURE

Following an introduction to the Guide in **Chapter 1, Chapter 2** provides background, a description of the industry in Ontario, and a review of emerging sector issues that may influence its viability in the future.

**Chapter 3** **Products, Generic Processes and Utilities,** provides a description of the main process operations used by automotive parts manufacturers and describes the typical energy, water and material inputs, and outputs. While each facility is different, the generic unit processes should be similar.

**Chapter 4** **Resource Utilization,** provides a discussion of energy, water and material use and costs for the sector.

**Chapter 5** **Sector Benchmarking,** offers a short introduction to the calculation of unit performance ratios, a useful method for assessing and tracking waste generation, water, solvent and energy usage within a facility.

**Chapter 6** **Generic Opportunities for Resource Conservation, Pollution Prevention and Source Reduction,** provides details on available opportunities to improve environmental performance while reducing costs. This section focuses on opportunities for process improvements, energy reduction water reduction, chemical management, wastewater treatment, reducing air emission, reducing waste generation and environmental management strategies.

**Chapter 7** **Priorities and Implementation,** offers a summary of the opportunities identified in Chapter 6 as well as worksheets to assist in identifying costs and priorities for implementation.

**Chapter 8** **New Technologies,** provides a concise overview of some technologies currently under development or undergoing field testing that will become commercially available over the next three to ten years.

**Chapter 9** **Validation of Resources Conservation and Pollution Prevention,** provides examples of other automotive parts facilities that have implemented pollution prevention measures.

**Chapter 10** **Other Helpful Information,** contains an annotated compilation of other publications and information sources for use in conservation initiatives.

**Appendix A** **Industrial Energy Innovators Initiative,** provides information on the Federal Government Initiative to reduce energy consumption.

**Appendix B** **Voluntary Challenge and Registry Program (VCR),** provides information on how to join this Federal Government Program aimed at reducing emissions of Greenhouse Gases.

## FOLLOW UP SERVICES AVAILABLE

The Industry Conservation Branch (ICB) of the Ministry of the Environment can provide assistance to companies developing a resource conservation plan. Utility bill analysis is a service offered to Ontario companies as the first step in conducting a resource use assessment of a plant. The analysis provides a quick indicator of an individual company's energy and water consumption patterns and the efficiency of operations. Immediate savings can often be identified in the analysis of gas, electricity, oil and propane, and water consumption patterns. A follow-up plant "walk-through" analysis identifies potential operational savings in energy, water and other process-related resource use in the facilities. Companies can then pursue resource conservation opportunities using their own technical staff or with the assistance of an external consultant. Contact the Industry Conservation Branch by fax at (416) 327-1261 (to the attention of Ana Rosati) or e-mail (rosatian@ene.gov.on.ca) for more information on these services.

# Table of Contents

# 1.0 INTRODUCTION

## 1.1 BACKGROUND

Proctor & Redfern Limited was engaged by the Ministry of the Environment to prepare a "Guide to Resource Conservation and Cost Savings Opportunities in the Automotive Parts Manufacturing Sector". The initiative is aimed at helping Ontario industry to use energy and water more efficiently and to reduce or eliminate air emissions, liquid effluents and solid wastes.

## 1.2 SCOPE OF STUDY

The scope of this study is to provide plant engineers, operators, maintenance and plant management staff a working document which will summarize cost savings opportunities related to the use of resources (energy, material and water) and environmental opportunities which could be employed throughout the automotive parts manufacturing industry. In particular this study included the following:

Development of a Sector Profile which included a description of the sector, the number and sizes of plants, current economic status, relevant legislation, regulations, standards and emerging sector issues.

Description of Products and Generic Processes including components of the engine, transaxle, body structure, chassis/suspension, seats/trim and HVAC system.

Description of Resource Utilization in particular an estimate of energy and water usage was determined.

Description of Process Residuals (i.e. air emissions, wastewater, and waste) is summarized and tabulated by chemical compound and type of release.

Generic Process and Utility Descriptions. Manufacturing process description included a discussion of the types and quantities of utilities required (fuel, electricity, water, compressed air, cooling water, and steam).

Process Improvement Opportunities: The process improvement opportunities focused on three areas: Energy; VOC and $NO_x$ emissions; and Waste Water. In summary, the process improvement opportunities investigated are as follows:

***Energy***

- Electrical: power factor; lighting; motors; and purchasing strategy
- Compressed Air: efficiency; leaks; modes of operation; and maintenance
- Cooling Water: efficiency; leaks; modes of operation; and maintenance

- Boilers & Steam Distribution: natural gas versus oil versus co-generation; operating efficiencies; steam traps; condensate return efficiency; modes of operation; and maintenance

- Monitoring Systems: applicability; and modes of operation

***Water & Materials***

- Reduction Opportunities

***Waste Water***

- Reduction Opportunities

- Treatment Options

***Air Emissions***

- VOCs & $NO_x$: CCME Initiative, Ontario Smog Plan

- Welding Processes: collection efficiencies; and control technologies

- Painting Processes: transfer efficiencies; application technologies; control technologies

***Management Strategies***

- Environmental Management Systems

- ISO 14001 Certification

Identification of New Technologies: Where appropriate, potential new technologies available were highlighted.

Sector Benchmarking: Unit energy, water and product losses were calculated to provide benchmarks against which facilities can judge their performance.

## 1.3 STUDY METHODOLOGY

To ensure that the project resulted in practical, implementable reduction opportunities in a cost effective and efficient manner, Proctor & Redfern (P&R) study team members worked closely with the APMA, the Technical Committee and sector representatives to obtain feedback on identified opportunities and constraints.

The following outlines specific work tasks that were undertaken over the course of the project:

1. Background information on the Sector was collected including information on size, number of plants, number of employees and economic status.

2. Project team members met with the APMA, Technical Committee and sector representatives on numerous occasions in the months of January 1997 to June 1997.

3. As required by the Terms of Reference of the study, two separate Reports have been produced as detailed below:

    - Sector Guide; and

    - Executive Summary (Published separately as well as being included with the Sector Guide).

4. In order to facilitate implementation of opportunities identified, worksheets were developed that allowed individual automotive parts facilities to calculate the financial impact of implementing the specific opportunities.

## 1.4 REPORT FORMAT

Chapter 2 of this report provides a description of the Sector including the number and sizes of plants, current economic status, relevant legislation and a discussion of issues related to the Sector. Chapter 3 provides a general discussion of the types of products produced by the Sector, the manufacturing processes and process residual generation. Chapter 4 summarizes the Sector's energy, water and raw material consumption. Chapter 5 provides information for sector benchmarking. Green Analysis activities and green efficiency opportunities identified in the study are described in Chapter 6. Chapter 7 provides a summary checklist of conservation measures and worksheets to aid in implementation. Chapter 8 discusses new technologies that are emerging. Case studies that provide validation of resource conservation implementation are provided in Chapter 9. Chapter 10 provides other helpful information including a list of suppliers, association, guidance documents and references.

# 2.0 SECTOR PROFILE

The following section provides a profile of the automotive parts sector including principal sector activities, number and sizes of plants, current economic status, relevant legislation, and a discussion of emerging sector issues.

## 2.1 SECTOR ACTIVITIES

The automotive parts sector includes facilities that manufacture motor vehicle parts, systems and accessories for use in motor vehicles, such as engines, brakes, clutches, axles, gears, transmissions, wheels, frames, radiators, springs, automotive hardware, heaters, horns, mirrors, seats, and motor vehicle fabrics.

The Automotive Parts Manufacturers' Association (APMA) is the national association representing original equipment manufacturers (OEM) producers of parts, equipment, tools, supplies and services for the worldwide automotive industry. The Association was founded in 1952 and has 400 members which account for ninety percent of the independent parts production in Canada. The APMA has provided valuable support in the preparation of this report and has facilitated input from member firms.

## 2.2 NUMBER AND SIZES OF PLANTS

For 1994, Statistics Canada reported a total of 423 automotive parts facilities in Ontario. This represents approximately 75% of the facilities in Canada. Other major provinces with facilities are Quebec (14%) and British Columbia (6%). The vast majority of Ontario manufacturing sites are located between Oshawa and Windsor, reflecting Ontario's proximity to the geographic core of American manufacturing capacity.

Table 2.1 provides a summary of number of automotive parts manufacturers by SIC code. This data divides the automotive parts sector into eight sub-sectors. The largest of these sub-sectors are stamping, plastic parts, wheel and brake, and steering and suspension parts. A pie chart showing the relative sizes of the sub-sectors is provided in Figure 2.1

As shown in Figure 2.2 and Table 2.2, the majority (70%) of firms have less than 200 employees. However, the firms that employ over 200, account for 79% of the shipments and 70% of the employment in the industry.

## 2.3 CURRENT ECONOMIC STATUS

The automotive parts industry plays an important role in the Canadian and in particular the Ontario economy. In 1995, automotive parts sales in Canada were $21 billion. Projected sales for 1996 are $23 billion with Ontario accounting for approximately 95% of these sales. Annual growth in automotive sales was 8.1%

**TABLE 2.1**
**NUMBER OF PLANTS IN ONTARIO (1994)**

| SIC CODE | SUB-SECTOR DESCRIPTION | ESTABLISHMENTS | |
|---|---|---|---|
| | | NUMBER | PERCENTAGE |
| 3251 | Motor Vehicle Engine and Engine Parts Industry | 28 | 6.6% |
| 3252 | Motor Vehicle Wiring Assemblies Industry | 20 | 4.7% |
| 3253 | Motor Vehicles Stamping Industry | 76 | 18.0% |
| 3254 | Motor Vehicle Steering and Suspension Parts Industry | 33 | 7.8% |
| 3255 | Motor Vehicle Wheel and Brake Industry | 33 | 7.8% |
| 3256 | Plastic Parts and Accessories for Motor Vehicle Industry | 51 | 12.1% |
| 3257 | Motor Vehicle Fabric Accessories Industry | 22 | 5.2% |
| 3259 | Other Motor Vehicle Accessories, Parts and Assemblies Industries | 160 | 37.8% |
| | Total | 423 | 100.0% |

Source: Statistics Canada Catalogue 31-203-XPB

**FIGURE 2.1**
**DISTRIBUTION OF TYPES OF FACILITIES IN ONTARIO**

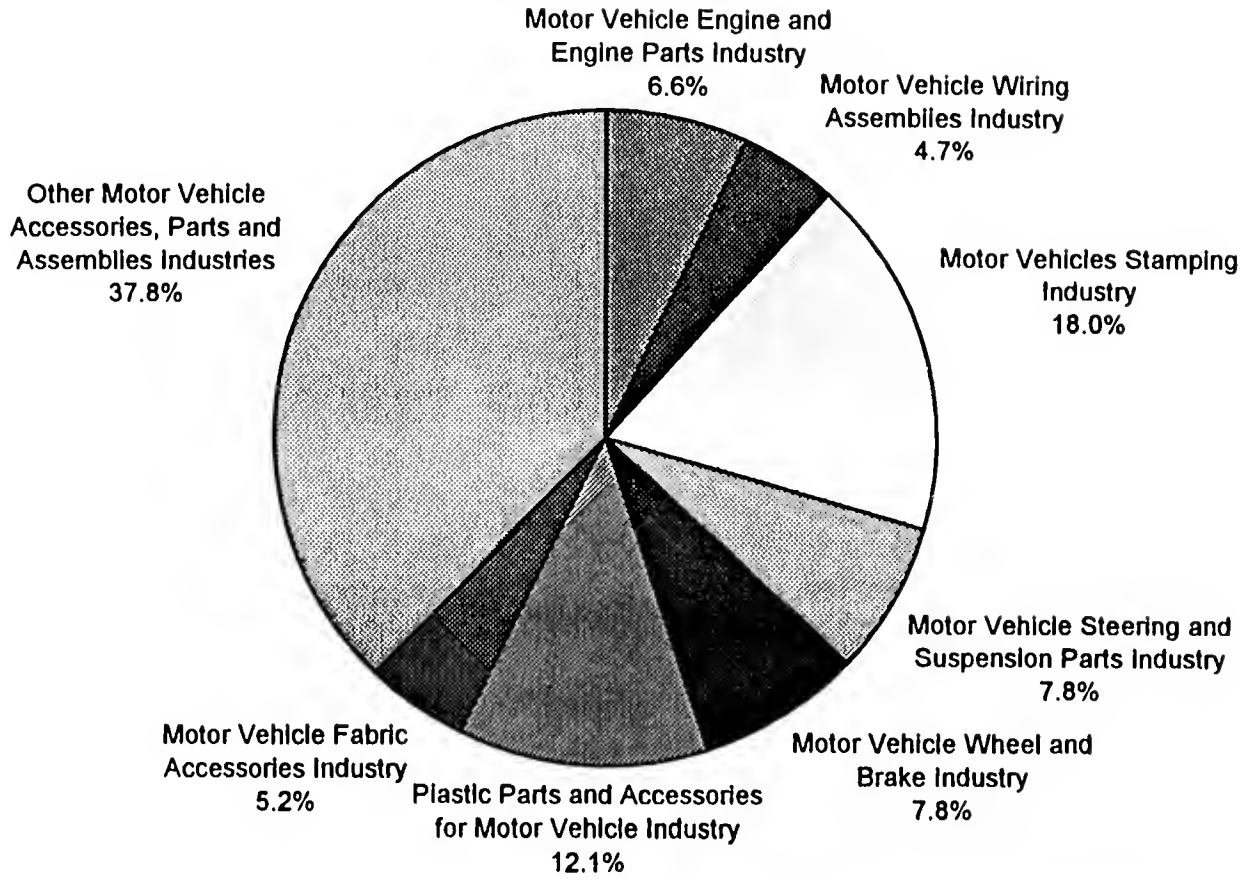
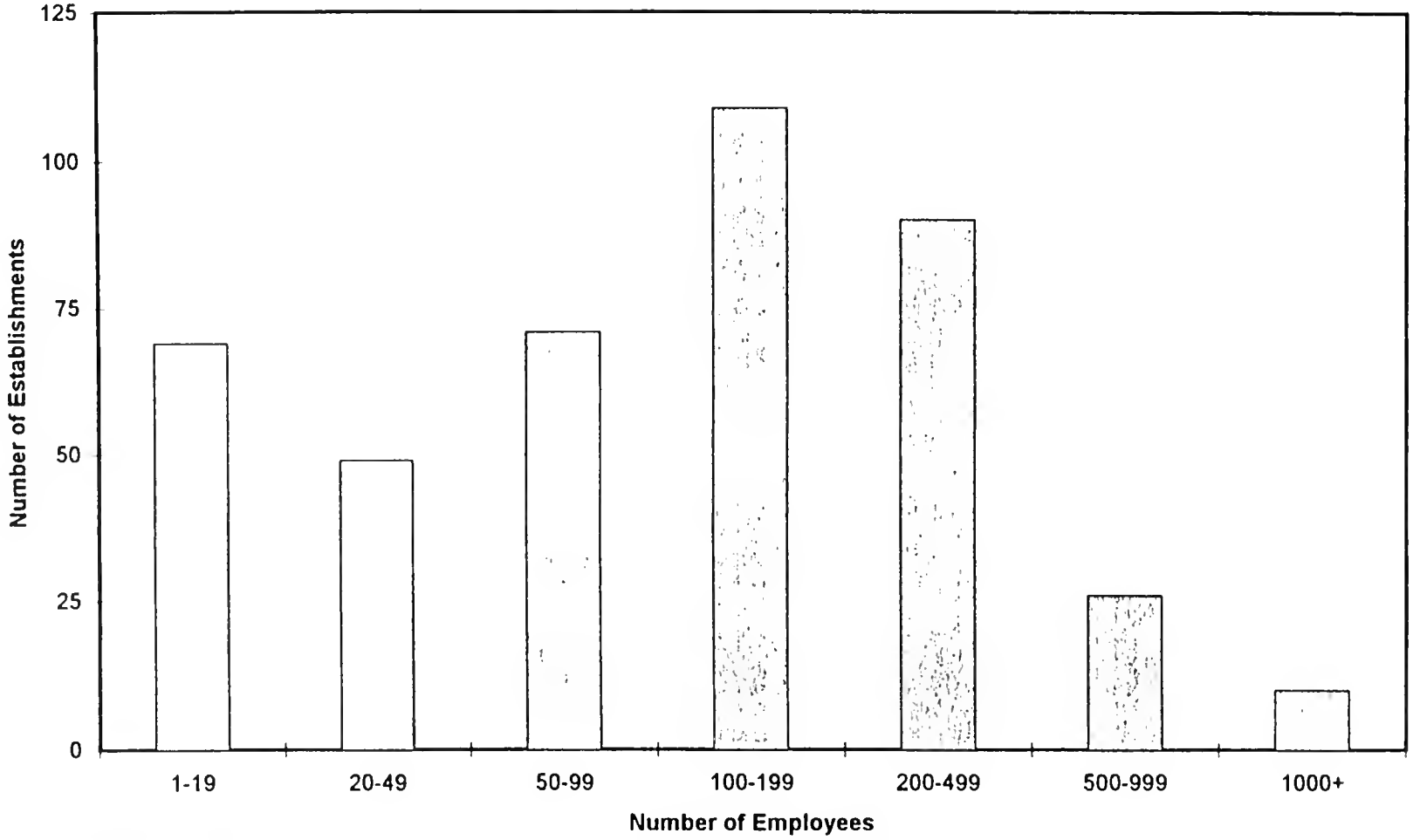


**FIGURE 2.2**
**DISTRIBUTION OF EMPLOYMENT BY FACILITY SIZE (ONTARIO, 1994)**




Source: Statistics Canada

**TABLE 2.2**
**NUMBER OF ESTABLISHMENTS BY EMPLOYMENT SIZE RANGE (ONTARIO, 1994)**

| SIC CODE | SUB-SECTOR DESCRIPTION | EMPLOYMENT SIZE RANGE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1-19 | 20-49 | 50-99 | 100-199 | 200-499 | 500-999 | 1000+ | Total |
| 3251 | Motor Vehicle Engine and Engine Parts Industry | 6 | 2 | 4 | 11 | 2 | 1 | 2 | 28 |
| 3252 | Motor Vehicle Wiring Assemblies Industry | 4 | 1 | 3 | 5 | 5 | 1 | 1 | 20 |
| 3253 | Motor Vehicles Stamping Industry | 10 | 7 | 16 | 26 | 13 | 3 | 2 | 77 |
| 3254 | Motor Vehicle Steering and Suspension Parts Industry | 3 | 5 | 6 | 7 | 9 | 3 | 0 | 33 |
| 3255 | Motor Vehicle Wheel and Brake Industry | 6 | 5 | 6 | 7 | 7 | 2 | 0 | 33 |
| 3256 | Plastic Parts and Accessories for Motor Vehicle Industry | 5 | 6 | 6 | 14 | 16 | 3 | 1 | 51 |
| 3257 | Motor Vehicle Fabric Accessories Industry | 3 | 1 | 4 | 3 | 7 | 3 | 1 | 22 |
| 3259 | Other Motor Vehicle Accessories, Parts and Assemblies Industries | 32 | 22 | 26 | 36 | 31 | 10 | 3 | 160 |
| | Total | 69 | 49 | 71 | 109 | 90 | 26 | 10 | 424 |

Source: Statistics Canada, Catalogue 31-203-XPB

in 1994/1995 and is anticipated to be over 10% in 1995/1996. Tables 2.3 and 2.4 provide a summary of the economic profile for the automotive parts sector and the various sub-sectors.

## 2.4 RELEVANT LEGISLATION, REGULATIONS AND STANDARDS

This section discusses the environmental legislation from the federal, provincial and municipal governments that may apply to this sector.

**Canadian Environmental Protection Act** (R.S.C. 1985, c.16, 4th Supp.) regulates release of toxic substances including PCBs, CFCs, lead, asbestos and mercury.

- **Storage of PCB Materials Regulation** (SOR/92-507) governs the federal requirements for storage and handling of PCB wastes in much the same manner as the provincial regulation.

- **Ozone Depleting Substances Regulations** (SOR/95-576) controls the import, manufacture, use, sale and export of bulk ozone depleting substances.

- **Ozone Depleting Products Regulation** (SOR/95-584) controls the manufacture, sale and manufacture of products made with or containing certain ozone depleting substances.

- **Ozone Depleting Substances Regulation No. 4** (SOR/93-214) controls specific to material containing tetrachloromethane (carbontetrachloride) or 1,1,1-trichloroethane (methyl chloroform).

- **Secondary Lead Smelter Release Regulation** (SOR/91-155) controls the release of air emissions of lead from secondary lead smelters.

**Transportation of Dangerous Good Act, 1992** (S.C. 1992, c.34) and Regulation apply to the movement of dangerous goods within Canada by all modes of transport. The legislation has specific requirements to ensure safe transport of dangerous goods including prescribed safety marks, shipping documents, warning labels and placards, and procedures relating to spill notification and emergency preparedness.

**Environmental Protection Act** (R.S.O. 1990) governs the main issues of environmental protection. Legislation includes requirements for Certificates of Approval, spill response, and prevention of adverse effects. The applicable regulations are provide below.

- **General Air Pollution Regulation** (R.R.O 1990, Reg. 346) sets out maximum air contaminant concentrations at sensitive receptors (i.e. residences, schools, etc.). The Regulation also includes a dispersion model

| TABLE 2.3<br>ECONOMIC PROFILE ($ MILLIONS) | | | | | |
|---|---|---|---|---|---|
| ECONOMIC INDICATOR | 1994 CANADA | 1994 ONTARIO | 1995 CANADA | INCREASE 1994/1995 CANADA | 1996 (1ST HALF) CANADA |
| Value of Parts Shipments | $19,423.8 | $18,608.0 | $20,992.9 | 8.1% | $11,842.4 |
| Total Exports | $14,277.9 | $13,492.6 | $14,664.4 | 2.7% | $8,219.4 |
| Total Imports | $28,007.5 | $26,383.1 | $30,265.6 | 8.1% | $15,963.0 |
| Trade Balance | ($13,729.7) | ($12,890.4) | ($15,601.2) | 13.6% | ($7,743.6) |
| Employment (# of persons) | 83,800 | 79,191 | 88,100 | 5.1% | 90,300 |

Source: DRI 1994, APMA 1997 Directory

**TABLE 2.4**
**ECONOMIC PROFILE BY SUBSECTOR (CANADA, 1994)**

| SIC CODE | SUB-SECTOR DESCRIPTION | % OF SHIPMENTS BY THIS SECTOR | % OF TOTAL EXPORTS BY THIS SECTOR | % OF TOTAL IMPORTS BY THIS SECTOR | % OF TOTAL TRADE SURPLUS FOR THIS SECTOR |
|---|---|---|---|---|---|
| 3251 | Motor Vehicle Engine and Engine Parts Industry | 14.6% | 25.5% | 26.9% | 24.2% |
| 3252 | Motor Vehicle Wiring Assemblies Industry | 5.6% | 7.1% | 1.8% | 12.0% |
| 3253 | Motor Vehicles Stamping Industry | 16.9% | 19.0% | 12.0% | 25.5% |
| 3254 | Motor Vehicle Steering and Suspension Parts Industry | 7.3% | 7.5% | 7.2% | 7.9% |
| 3255 | Motor Vehicle Wheel and Brake Industry | 6.8% | 7.5% | 10.9% | 4.4% |
| 3256 | Plastic Parts and Accessories for Motor Vehicle Industry | 8.1% | 0.2% | 5.1% | -4.4% |
| 3257 | Motor Vehicle Fabric Accessories Industry | 9.7% | 1.4% | 6.2% | -3.1% |
| 3259 | Other Motor Vehicle Accessories, Parts and Assemblies Industries | 31.0% | 31.9% | 29.9% | 33.6% |
| | Total | 100% | 100% | 100% | 100% |

Source: Statistics Canada/Industry Canada Business Integrated Database

that can be used to calculate the impact of emission sources on sensitive receptors. Standards are provided for over 100 air contaminants including nitrogen oxides, carbon monoxide, xylene, toluene and methyl ethyl ketone.

- **Ambient Air Quality Regulation** (R.R.O. 1990, Reg. 337) sets out maximum ambient air quality criteria for a number of pollutants.

- **General Waste Management Regulation** (R.R.O. 1990, Reg. 347 (as amended)) governs the handling of hazardous waste. Subject waste is moved according to a manifest system by a licensed carrier.

- **Waste Management - PCBs Regulation** (R.R.O. 1990, Reg. 362) governs the management of out of service PCBs equipment and PCB waste.

- **Waste Audits and Waste Reduction Workplans Regulation** (O. Reg. 102/94) requires that major industrial, commercial and institutional waste generators conduct waste audits and prepare waste reduction workplans.

- **Industrial, Commercial and Institutional Source Separation Programs Regulation** (O. Reg. 103/94) requires that qualifying facilities (over 10,000 $m^2$) implement source separation programs for recyclable materials.

- **Refrigerants Regulation** (O. Reg. 189/94 as amended 797/94) prohibits the discharge of a refrigerant into the natural environment and requires persons qualified under O.Reg 189/94 to service or test equipment containing specified refrigerants.

- **Boilers Regulation** (R.R.O. 1990, Reg. 338) prohibits the use of fuel oil or coal with a sulphur content greater than 1% in new and modified boilers.

- **Ozone Depleting Substances - General** (R.R.O. 1990, Reg. 356) prohibits the use of specified ozone depleting substances.

- **Solvents** (O. Reg. 719/94) prohibits the manufacture, sale discharge, use of class 1 ozone depleting substances.

- **Halon Fire Extinguishing Equipment** (O. Reg. 413/94) prohibits the discharge of certain types of halons used in fire extinguishing equipment. This regulation is designed to phase out the use of halons in fire extinguishing equipment.

**Ontario Water Resources Act** (R.R.O. 1990, c. O.40) prohibits the discharge into any water of any polluting material that may impair the quality of the water.

**Municipal Sewer Use By-Law** regulates discharges into sanitary, combined and storm sewers. Each municipality has its own by-law, but most were developed from the model by-law prepared by the MOE. For some parameters (i.e. BOD, suspended solids, and phosphorus) facilities can enter into a sewer surcharge agreement with the municipality whereby the company pays a surcharge for overstrength wastewater discharges.

Ontario Regulation 82/95 under the **Energy Efficiency Act** requires that specific products and appliances meet minimum efficiency levels. The equipment affected includes residential appliances, heat pumps, air conditioner, chillers, water heaters, furnaces, boilers, and lighting.

The following is a list of other legislation that may have sections relevant to environmental issues:

- Pesticides Act (R.S.O. 1990, c. P.11)
- Pesticides Regulation (R.R.O. 1990, Reg. 914)
- Gasoline Handling Act (R.S.O. 1990, c. G.4)
- Gasoline Handling Regulation (O. Reg. 521/93)
- Gasoline Handling Code
- Energy Act (R.S.O. 1990. c. E.16)
- Fuel Oil Code (R.R.O. 1990, Reg. 329)
- Fire Marshals Act (R.R.O. 1990, C. F.17)
- Fire Code (R.R.O. 1990, Reg. 454)

### 2.5 Emerging Sector Issues

A number of major trends are occurring in the automotive parts industry that will have a major impact on parts suppliers in the years ahead. Among the more significant trends are:

(1) There is an ongoing decline in the number of direct (or Tier 1) suppliers. The number of direct suppliers has declined from over 2,500 in 1985 to approximately 1,500 in 1996 and is expected to further decline to 375 by the year 2005.

(2) Contributing to the decline in the number of direct suppliers is the ongoing wave of mergers and acquisitions as well as the consolidation of supply sources by the automotive OEM. The goal of the assemblers through programs such as the Chrysler CDP Program is to ultimately be dealing with only one or two suppliers for all major component systems.

(3) Supplier responsibility is growing to include added R&D, design, product engineering, process engineering, and project management responsibility. By 2005, system integrators (Tier 1s) supplying complete parts systems will have the lead role in the supply chain for product development, quality assurance, and product cost.

(4) Supplier relationships with assemblers, and with each others, in the supply chain is changing. With assemblers, suppliers are taking on more of a partnering role. Within the supply chain, parts makers are finding that they

may serve as partners, competitors, suppliers or customers with the same company at different times.

(5) The need to reduce costs and to work with smaller margins will continue into the future. At the same time, suppliers may find themselves taking on added warranty responsibility.

(6) Parts suppliers are expected to follow their assembler customers around the globe.

(7) The auto assemblers, with the aid of their suppliers, are working to commonize designs and components across platforms.

These changes are bringing about a new view of suppliers that differs in important ways from the traditional tier structure and a whole new way of viewing the supply chain.

The major trends that are occurring in the automotive parts industry are bringing about significant issues for Canadian parts companies to consider.

Among these issues are:

(1) Where, and how, a company should be positioned in the supply chain;

(2) What effect will a new view of supply chain dynamics from a tiered system to a system based on capabilities, geographic scope and range of services offerings have on suppliers;

(3) How to develop more horizontal cooperative relationships in the supply chain similar to the Japanese *kyoryokukai*;

(4) How to cope with taking on added supply chain responsibilities while continuing to reduce prices and margins;

(5) The need to lower internal costs of operation, reduce material cost, increase volume and innovate new products and technologies to meet assembler target pricing programs;

(6) Understanding and responding to the drivers in assembler single source selection;

(7) Meeting QS-9000 deadlines and certification requirements;

(8) Implementation of an ISO 14001 Environmental Management System;

(9) Finding the resources to fulfill the expanded role that parts suppliers are expected to undertake by the turn of the century;

(10) Determining ways to grow to serve international markets or better protect home markets from new competitors;

(11) How to handle increased warranty responsibilities; and

(12) How to react to new partnering relationships with the assemblers.

# 3.0 PRODUCTS, GENERIC PROCESSES AND UTILITIES

## 3.1 PRODUCTS

The following is a listing of products manufactured by the automotive parts sector:

- motor vehicle engines and engine parts - alternator, crankshaft, camshaft, carburetor, cylinder head, distributor, manifold, piston, rocker arm
- motor vehicle wiring assemblies - battery heater, block heater, cigarette lighter, defroster, heaters, electronic ignition, electric lighting, ignition coils, horn, spark plugs, wiring harness
- motor vehicle stamping - bumpers, fuel tank, fender, door, hood, body
- motor vehicle steering and suspension parts - chassis springs, shock absorbers, spindles, steering columns, steering wheels, suspension control arms, sway bar assembly, tie rods, torsion bars
- motor vehicle wheel and brake - brake cylinders, brake drums, disc brake assemblies, hub caps, tire valves, wheels (rims), wheel side rings
- plastic parts and accessories - plastic fenders, plastic lens, plastic grills, mudguards, plastic trim, and plastic panels
- motor vehicle fabric accessories - seat covers, seat belts, seat cushions and backs, fabric trimmings
- other motor vehicle accessories, parts and assemblies - clutch assemblies, differential and rear axle assemblies, drive shafts, exhaust and tail pipes, filters, jacks, mirrors, mufflers, radiators, tire chains, trailer hitches, transmissions, universal joints

## 3.2 GENERIC PROCESSES AND UNIT OPERATIONS

Numerous different processes are used to produce the metal, plastic and other diverse types of parts manufactured for use in automotive assembly. Most processes that fabricate parts from metal typically include casting, forging, molding, extrusions, stamping, welding and painting. For the production of plastic parts, typical processes include molding, drying and painting. The following section provides an overview of the generic processes used by the automotive parts sector and also discusses the utilities required and process residuals generated.

### 3.2.1 Casting

Iron and steel cast metal products are produced in foundries. A process flow diagram showing the raw material inputs and outputs for foundry operations is provided in Figure 3.1. The basic foundry operations are summarized as follows. The core, which is the internal section of the casting used to produce open areas needed inside the cast, is created using sand and binders (which can contain phenol and/or formaldehyde). After the core is made, it is assembled with the rest of the casting mold in preparation for casting. The charge (i.e. iron) is combined with coal and other additives such as calcium carbide and magnesium, and fed into a furnace. Once the charge has reached the appropriate temperature it is poured into the mold. The mold then proceeds through a cooling tunnel and is placed on a conveyor to undergo 'shakeout' to loosen the casting from the mold and core sand.

The part then undergoes a finishing process to remove any unnecessary metal parts (i.e. gates and sprues) and any remaining sand, or it may be pickled using acids to achieve the correct surface. After finishing, the parts may undergo final heat treatment prior to inspection and shipment to the assembly area.

Wastewater is generated during the slag quenching operations and by wet scrubbers used as air pollution control (APC) devices for the furnaces, metal pouring areas, and shakeout operations. Due to the presence of cadmium and lead in iron, and phenol and formaldehyde in the binders, these contaminants may be present in wastewaters. Solid hazardous waste, calcium chloride desulphurization slag, is generated during the melting of the iron.

### 3.2.2 Stamping

Stamping involves the shaping of metal components, usually from coiled steel. A process flow diagram showing the raw material inputs and outputs for stamping operations is provided in Figure 3.2. Shearing and forming operations are performed to cut materials into the desired shape and size and bend or form the material into specific shapes. Many automotive parts, such as fenders, hubcaps and body parts, are manufactured in metal fabricating shops.

In metal fabricating, lubricating fluids are used to keep workpiece and tool temperature down, reduce tool wear, provide a good finish, wash away metal debris and inhibit corrosion. These fluids can be either petroleum-based, oil-water emulsions or synthetic emulsions.

A new technology that is currently in development that may replace box-section stamping assemblies. Hydroforming is a process that starts with a straight or bent, welded, round tube that is place into a forming die. The tube is then filled with water at high pressure to force the tube to conform to the shape of the die cavity. More details are provided in Sections 6.1.1 and 8.2.3.

**FIGURE 3.1**
**CASTING FLOWSHEET**

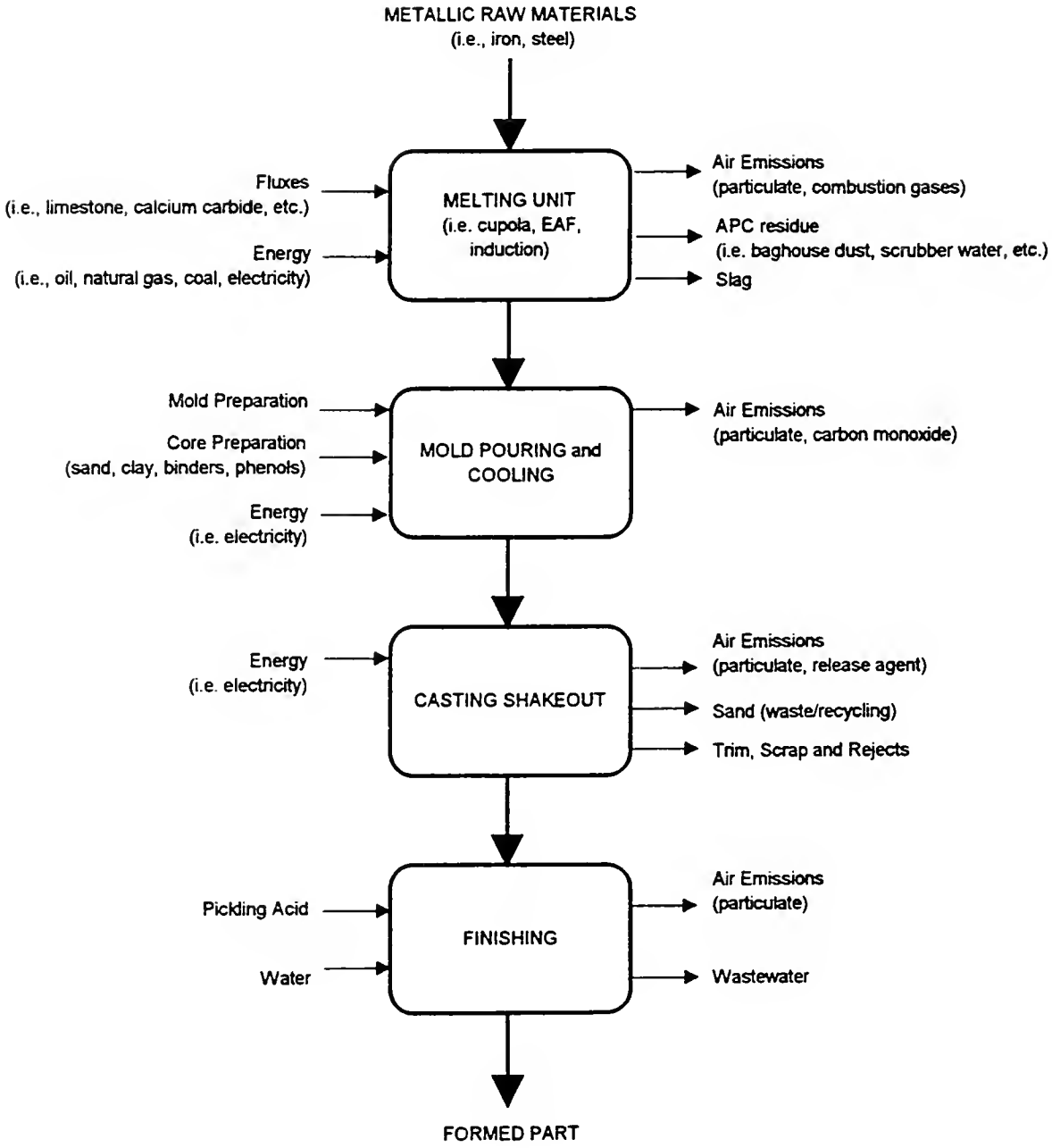
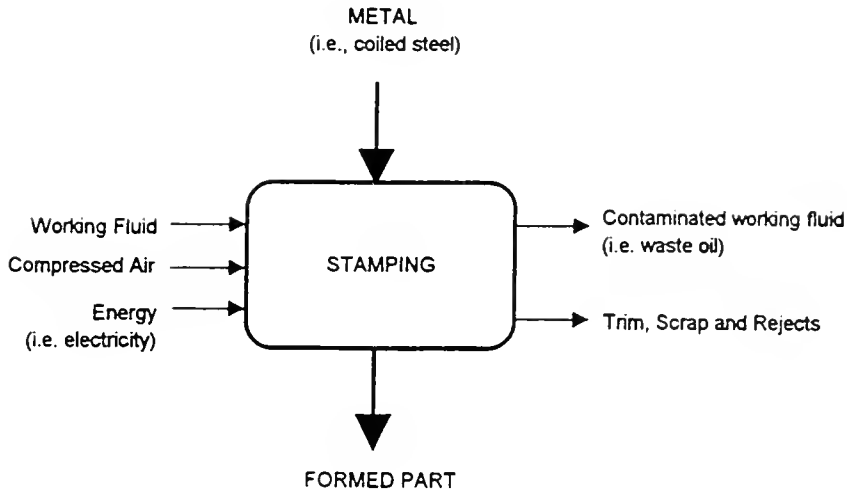


**FIGURE 3.2**
**STAMPING FLOWSHEET**



### 3.2.3 Forging

Forging consists of working the metal into a finished shape by hammering or pressing. Forged products include pistons, connecting rods, axles and crankshafts. There are three types of forging commonly used; hammer, drop and press forging. Hammer forging operations use repeated hammer blows to a red-hot blank to force the material to conform to the shape of the die opening. Drop forging is similar to hammer forging, except that material is dropped into the die as opposed to being struck repeatedly. Press forging works in a similar way, except it uses pressure to squeeze rather than strike the blank. Forging uses a series of die cavities to change the shape of the blank in increments. The blank is then moved from station to station in the die to form the part. A process flow diagram showing the raw material inputs and outputs for forging operations is provided in Figure 3.3.

### 3.2.4 Extrusion

Extruding is the process of forming a specific shape from a blank by forcing the blank through a die of the desired shape. In the hot extrusion process the heated piece of metal is placed in a chamber. A hydraulically operated ram applies pressure to the metal to force it to flow through a restricted orifice to produce the desired shapes. This process is commonly used to manufacture aluminum tubes. A process flow diagram showing the raw material inputs and outputs for extrusion operations is provided in Figure 3.4.

### 3.2.5 Machining

Machining operations include grinding, drilling, etc. whereby the parts are machined to smooth out surfaces or create specific tolerances. Cutting fluids are typically used to reduce the heat produced (especially in the case of aluminum parts) and to eliminate the hazards associated with the formation of dusts. A process flow diagram showing the raw material inputs and outputs for machining operations is provided in Figure 3.5.

### 3.2.6 Welding

Assembly of the automotive parts commonly involves welding by various methods to produce the required part. Welding is used to join metal parts by melting the parts at the points of contact and simultaneously forming a connection with molten metal from these same parts or from a consumable electrode. There are over eighty types of welding operations in commercial use. The most common of the methods used is electric arc welding. Examples of electric arc welding include shielded metal, gas metal, flux cored and submerged arc welding. A process flow diagram showing the raw material inputs and outputs for welding operations is provided in Figure 3.6.

**FIGURE 3.3**
**FORGING FLOWSHEET**

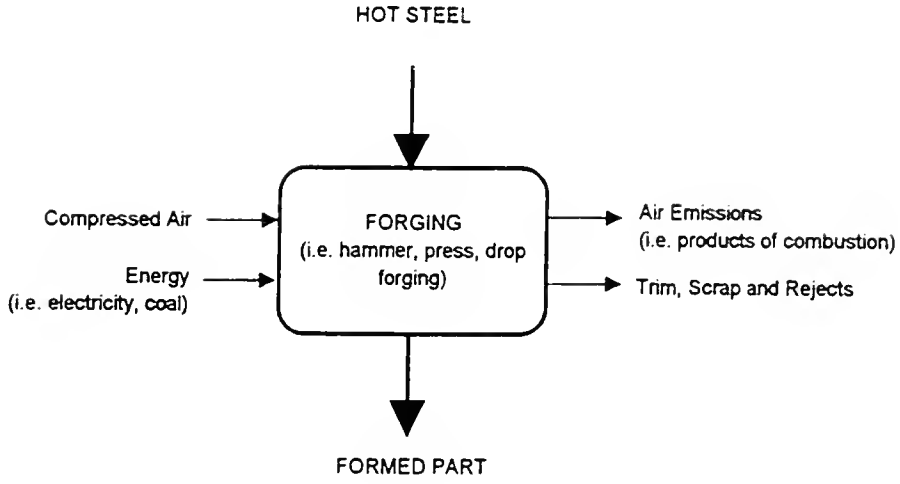


**FIGURE 3.4**
**METAL EXTRUSION FLOWSHEET**

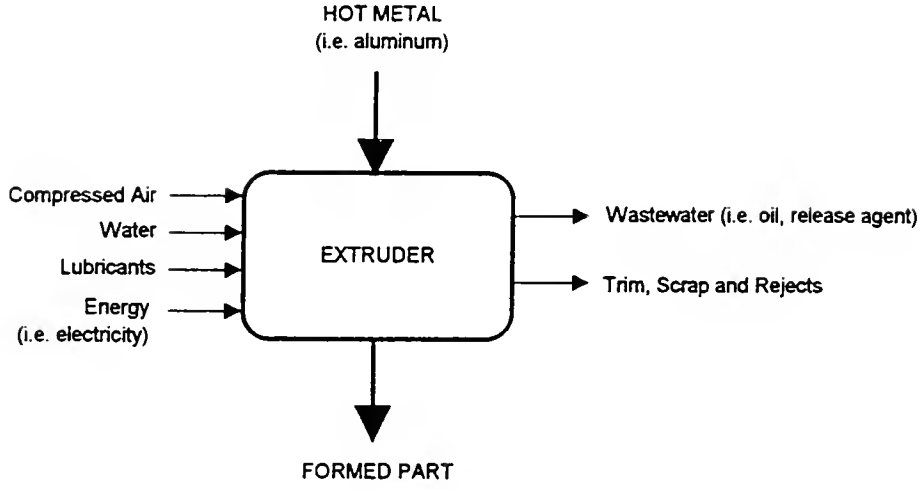


**FIGURE 3.5**
**MACHINING FLOWSHEET**

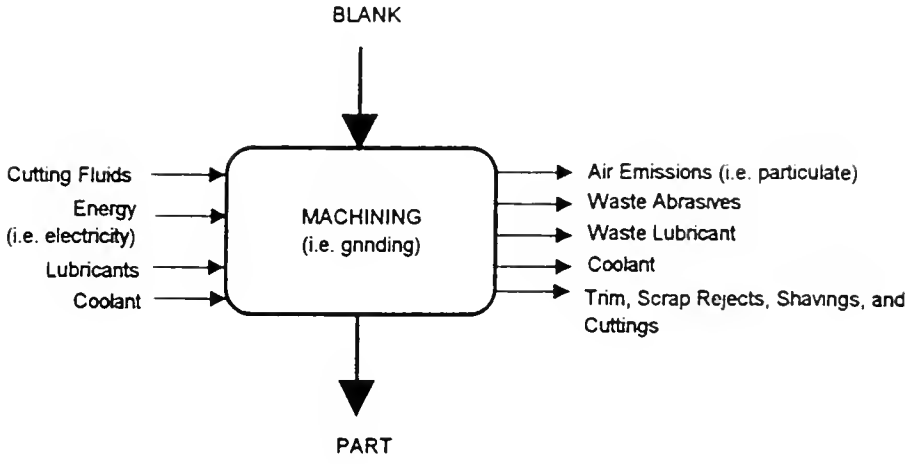
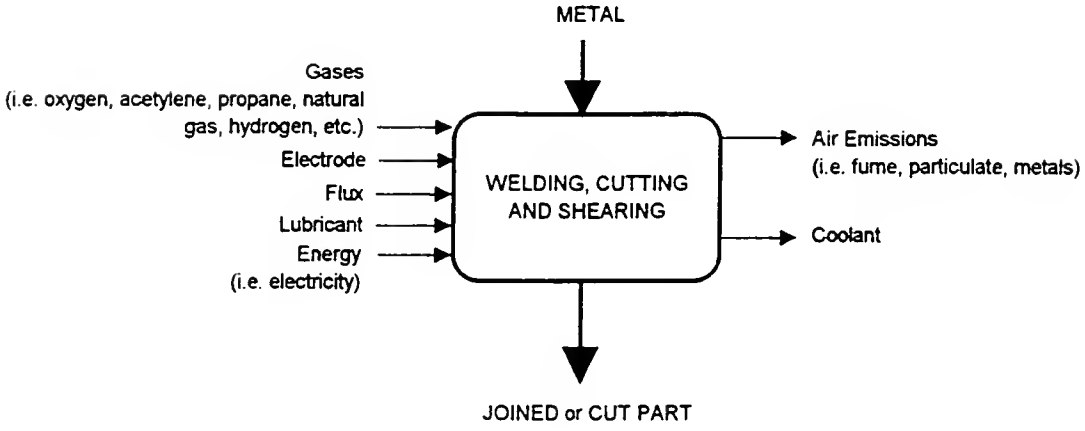


**FIGURE 3.6**
**WELDING, CUTTING AND SHEARING FLOWSHEET**



### 3.2.7 Plastics Molding

Although there are numerous processes used for plastics molding of automotive parts, the processes all essentially involve the use of a resin and the application of pressure or heat. Methods for plastics molding include casting, compression molding, injection molding, blow molding, extrusion, calendering and thermoforming. A process flow diagram showing the raw material inputs and outputs for plastics molding operations is provided in Figure 3.7.

### 3.2.8 Coating

A variety of types of coatings and methods of application are used to paint the surface of automotive parts. Types of coatings include solvent type paints, varnishes, powder type coatings, lacquers and water thinned paints. Application methods include rolling, spraying, dipping, electrostatic deposition, and flow coating. After application by these methods the parts are air/heat dried to remove volatile solvents. Powder type coatings are applied to a hot surface or can be melted after application and caused to flow together. A process flow diagram showing the raw material inputs and outputs for painting operations is provided in Figure 3.8.

## 3.3 Utilities; Process and Plant

The typical generic utilities used at automotive parts facilities are compressed air, water electricity, natural gas and other fuels, steam, and chilled water. The following discusses the main areas where these utilities are used and the main consumers.

### 3.3.1 Compressed Air

Compressed air is used for process applications and as instrumentation air. Typically screw type air compressors provide compressed air for process operations and reciprocating compressors are used in emergencies for operation of boiler instrumentation if the main air system fails. The major process uses are baghouse pulsing, blow downs of ion exchange columns, pneumatic conveying, pneumatic tools, paint application, and instruments.

### 3.3.2 Water

For the majority of facilities, process water is supplied by the local municipal water supply. Water is typically used as make-up water for the boilers and cooling towers, sanitary water, and wash water.

### 3.3.3 Electricity

The main consumers of electricity are air compressors, stamping presses, welding, casting, HVAC, pumps, motors, extruding and lighting.

**FIGURE 3.7**
**PLASTIC PARTS PRODUCTION FLOWSHEET**

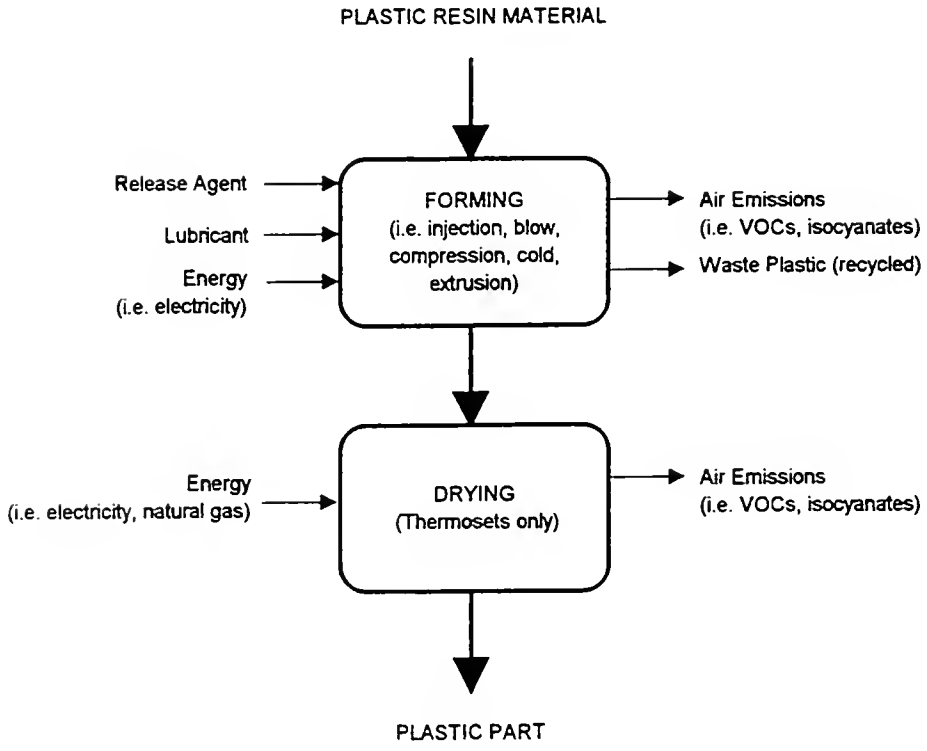
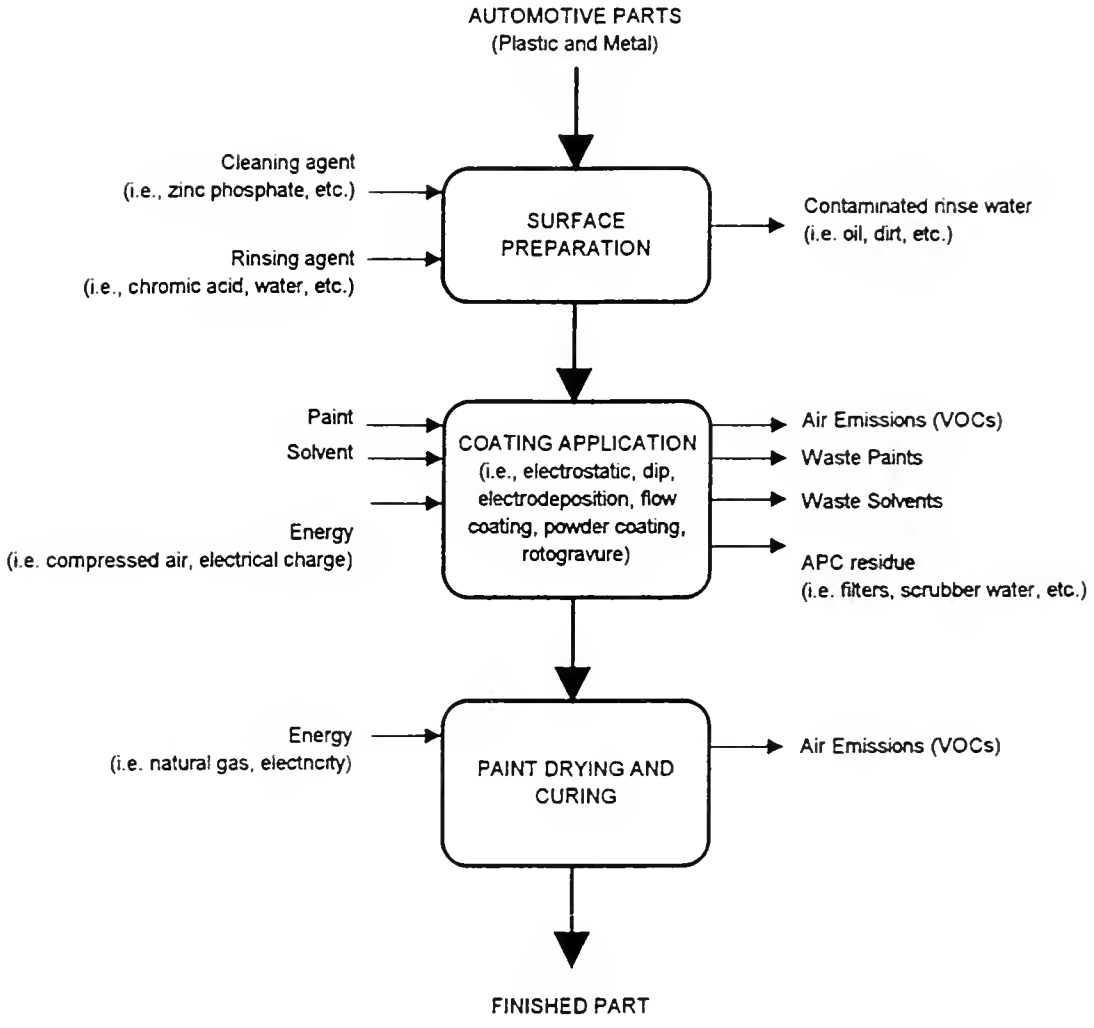


**FIGURE 3.8**
**COATING PROCESS FLOWSHEET**



### 3.3.4 Natural Gas and Other Fuels

Natural gas and/or fuel oil is used in process boilers to provide heating and process steam. The major steam uses include parts washing, forging, and building heating. Natural gas is also used for inert atmospheres in furnaces, material preheating, paint baking, cutting torches, casting, fume incinerators, and building heating.

### 3.3.5 Chilled Water

Chilled water is required from process cooling in many operations including calendering. It is typically generated by the use of refrigeration. Some of the older refrigeration units use CFCs and other ozone depleting substances that are cause for environmental concern. Measures to reduce/prevent environmental effects from refrigerants are addressed in section 6 of this report.

## 3.4 PROCESS RELATED RESIDUALS

The following sections discuss the process residuals (air emissions, wastewater discharges, and solid wastes) generated by the automotive parts sectors.

### 3.4.1 Air Emissions

The principal air emissions emitted from auto parts manufacturing are:

- VOCs - from painting, solvent cleaning and plastics manufacturing
- Products of Combustion - Nitrogen Oxides, Carbon Monoxide, Carbon Dioxide, Particulate and Sulphur Dioxide
- Particulate - from machining, casting, and welding

### 3.4.2 Liquid Residuals (Wastewater)

The principal sources of waste water from auto parts manufacturing are:

- Foundry Operations - wastewater generated during the slag quenching operations and by wet scrubbers. Due to the presence of cadmium and lead in iron, and phenol and formaldehyde in core binding agents, these contaminants may be present in wastewaters.
- Painting - wastewater generated by wet scrubbers
- Parts Cleaning - wastewater contaminated with oil, dirt, etc.
- Sanitary Wastewater - general wastewater from the plant
- Chemical Cleaning - acid/alkaline liquid wastes
- Solvent Cleaning - MEK, acetone, and others

- Oily Water - wastewater contaminated with oil

### 3.4.3 Solid Waste Residuals

The principal sources of solid waste generated from auto parts manufacturing are:

- Foundry Operations - slag and foundry sands generated during the melting of the metal
- Scrap Metal - generated by many parts forming and machining operations, and rejected parts
- Packaging - general raw material packing
- Painting - spraybooth filters, sludge
- Plastics - scrap and trim
- Baghouse Dust - particulate

# 4.0 RESOURCE UTILIZATION

## 4.1 ENERGY

In 1994, the Canadian automotive parts sector spent $260 million dollars on fuel and electricity. The average cost per facility was just under half a million dollars. The subsector with the highest per facility usage was the engine and engine parts subsector. A summary of the costs of fuel and electricity by subsector is provided in Table 4.1. As a percentage of sales, energy costs account for an average of 1.28%.

## 4.2 WATER

Data on water usage at nine automotive parts facilities in Ontario was collected under the Industrial Energy Services Program (IESP). Based on this limited data, the annual average water consumption at automotive part facilities is 44,573 $m^3$. As shown in Table 4.2, the annual average cost of water (including sewage charges) is $39,480. It should be noted that as Statistic Canada does not report water usage by industry, there is only limited data available in order to estimate water usage. With this limited data, water usage varies considerably from a low of 2,982 $m^3$/year to a high of 167,068 $m^3$/year.

For comparison, at General Motors in Oshawa water accounts for approximately 7% of the utility costs. If we prorate this based on the average cost per facility of fuel and electricity for the sector of $457,672 (see Table 4.1) the annual cost of water for the average facility in the sector would be $34,448.

## 4.3 MATERIALS

Currently the typical car contains the following materials (percent by weight):

- 70.2% Ferrous metals - sheet metal, forged steel, cast iron
- 21.1% Non-metals - including
    - 7.9% Plastics
    - 2.5% Fluids
    - 4.3% Rubber
    - 3.0% Glass
    - 3.4% Other
    - 8.7% Non-Ferrous Metals (aluminum, copper, lead, zinc)

**TABLE 4.1**
**RESOURCE UTILIZATION, CANADA 1994**

| SIC CODE | SUB-SECTOR DESCRIPTION | NUMBER OF ESTABLISHMENTS | COST OF FUEL AND ELECTRICITY | AVERAGE COST OF FUEL AND ELECTRICITY PER FACILITY |
|---|---|---|---|---|
| 3251 | Motor Vehicle Engine and Engine Parts Industry | 34 | $26,700,000 | $785,294 |
| 3252 | Motor Vehicle Wiring Assemblies Industry | 27 | $3,900,000 | $144,444 |
| 3253 | Motor Vehicles Stamping Industry | 82 | $44,400,000 | $541,463 |
| 3254 | Motor Vehicle Steering and Suspension Parts Industry | 42 | $29,900,000 | $711,905 |
| 3255 | Motor Vehicle Wheel and Brake Industry | 53 | $25,300,000 | $477,358 |
| 3256 | Plastic Parts and Accessories for Motor Vehicle Industry | 66 | $35,200,000 | $533,333 |
| 3257 | Motor Vehicle Fabric Accessories Industry | 33 | $11,100,000 | $336,364 |
| 3259 | Other Motor Vehicle Accessories, Parts and Assemblies Industries | 230 | $83,000,000 | $360,870 |
| | Total | 567 | $260,000,000 | $457,672 |

Source: Statistics Canada, Catalogue 42-251-XPB 1994

**TABLE 4.2**
**ESTIMATED WATER USE**

| SIC CODE | SUB-SECTOR DESCRIPTION | NUMBER OF FACILITIES SURVEYED | AVERAGE WATER CONSUMPTION ($M^3$) PER FACILITY SURVEYED | AVERAGE COST OF WATER AND SEWAGE PER FACILITY SURVEYED |
|---|---|---|---|---|
| 3251 | Motor Vehicle Engine and Engine Parts Industry | 1 | 53,884 | $24,434 |
| 3252 | Motor Vehicle Wiring Assemblies Industry | 0 | - | - |
| 3253 | Motor Vehicles Stamping Industry | 0 | - | - |
| 3254 | Motor Vehicle Steering and Suspension Parts Industry | 3 | 5,256 | $2,806 |
| 3255 | Motor Vehicle Wheel and Brake Industry | 0 | - | - |
| 3256 | Plastic Parts and Accessories for Motor Vehicle Industry | 2 | 62,403 | $30,898 |
| 3257 | Motor Vehicle Fabric Accessories Industry | 1 | 101,623 | $133,303 |
| 3259 | Other Motor Vehicle Accessories, Parts and Assemblies Industries | 2 | 103,348 | $130,337 |
| | Total | 9 | 44,573 | $39,480 |

## *RESOURCES UTILIZATION*

Information on materials used by automotive parts supplies compiled by Statistics Canada is summarized in Table 4.3. The automotive parts manufactures spent 9.8 billion dollars on materials. The main material cost is iron and steel. Automotive parts manufactures spent over $2 billion on iron and steel in 1994. This accounts for 20.9% of the total value of the materials. Oil based paints accounted for $100 million dollars in materials costs.

Some of the materials used in the manufacture of automotive parts are produced from recycled materials. The main material used, iron and steel, is the most recycled automotive material in use. In 1995, 13 million tons of steel were recovered from cars in North America. The advantage to recycled iron and steel is that they are equivalent to the virgin product and result in significant conservation of raw materials and energy.

**TABLE 4.3**
**MATERIAL USAGE (CANADA, 1994)**

| MATERIAL | NUMBER OF ESTABLISHMENTS REPORTING USE | VALUE ($'000,000) | % OF TOTAL VALUE OF RAW MATERIALS |
|---|---|---|---|
| Iron and Steel | 156 | 2061.5 | 20.9% |
| Parts and Accessories | 97 | 1774.4 | 18.0% |
| Engine Parts | 7 | 1107.8 | 11.3% |
| Plastics and articles thereof | 78 | 644.9 | 6.5% |
| Electrical Machinery | 20 | 496.8 | 5.0% |
| Aluminum and Articles of Aluminum | 44 | 351.1 | 3.6% |
| Rubber and articles thereof | 50 | 145.8 | 1.5% |
| Textile Fabrics | 16 | 101.5 | 1.0% |
| Oil Based Paints | 42 | 99.9 | 1.0% |
| Copper and Articles of Copper | 44 | 88.3 | 0.9% |
| Transmission Parts | 5 | 24.2 | 0.2% |
| Glass and Glassware | 10 | 22.1 | 0.2% |
| Woven Fabrics | 11 | 19.9 | 0.2% |
| Isocyanates | 5 | 19.0 | 0.2% |
| Ball or Roller Bearings | 3 | 11.1 | 0.1% |
| Carpets | 3 | 6.7 | 0.1% |
| Other | - | 9454.0 | 29.2% |
| Total raw materials, components, supplies | 312 | 9846.7 | 100% |

Source: Statistics Canada, Catalogue 42-251-XPB

Note: The category "Other" includes: glues, waxes, pickling preparations, binders, wood, paper, other metals, and other miscellaneous articles. The category "Parts and Accessories" includes: seat belts, interior trim, seat cushions, brake parts, wheels, cooling system parts, etc.

# 5.0 SECTOR BENCHMARKING PARAMETERS AND EFFICIENCIES

Sector benchmarking parameters are used to measure an individual company's performance against similar facilities. Benchmarks provide a frame of reference that help to identify areas where performance should be improved. Benchmarks also can be used to compare year to year changes at an individual facility.

In order to measure environmental performance benchmarks for energy use, water use, waste generation, wastewater generation and air emissions have been developed. Where data was available the average benchmark for each subsector has been provided.

## 5.1 ENERGY USE

### 5.1.1 Total Annual Energy Cost as a Percentage of Sales

Total energy cost as a percentage of sales is calculated by dividing the total cost for energy (gas, fuel oil and electric) by total sales times 100. The median performance for the sector is 1.28%. Table 5.1 provides the median performance for each subsector. The values range from a minimum of 0.34% for the motor vehicle wiring industry to a high of 2.04% for steering and suspension parts, and motor vehicle plastic parts.

For comparison, a study conducted in the United States of 76 metal forming companies found that the medium performance for annual energy costs as a percentage of sales was 1.24%. This is similar to the result for the motor vehicle stamping industry at 1.36%. The study also calculated a best practice (top 10% of companies) to be 0.65%.

### 5.1.2 Total Annual Energy Cost as a Percentage of Operating Costs

Total energy cost as a percentage of operating costs is calculated by dividing the total cost for energy (gas, fuel oil and electric) by total operating costs times 100. The median performance for the sector is 1.66%. Table 5.1 provides the median performance for each subsector. The values range from a minimum of 0.50% for the motor vehicle wiring industry to a high of 2.78% for motor vehicle wheel and brake industry.

### 5.1.3 Boiler Efficiency

Calculating the efficiency of a boiler provides information on the overall performance of the system. The simplest way to calculate fuel to steam

**TABLE 5.1**
**BENCHMARKING - ENERGY USE**

| SIC CODE | SUB-SECTOR DESCRIPTION | AVERAGE COST OF ENERGY (*) AS A PERCENTAGE OF: | |
|---|---|---|---|
| | | SALES | OPERATING COSTS |
| 3251 | Motor Vehicle Engine and Engine Parts Industry | 0.90% | 1.15% |
| 3252 | Motor Vehicle Wiring Assemblies Industry | 0.34% | 0.50% |
| 3253 | Motor Vehicles Stamping Industry | 1.36% | 1.80% |
| 3254 | Motor Vehicle Steering and Suspension Parts Industry | 2.04% | 2.60% |
| 3255 | Motor Vehicle Wheel and Brake Industry | 1.87% | 2.78% |
| 3258 | Plastic Parts and Accessories for Motor Vehicle Industry | 2.04% | 2.71% |
| 3257 | Motor Vehicle Fabric Accessories Industry | 0.53% | 0.67% |
| 3259 | Other Motor Vehicle Accessories, Parts and Assemblies Industries | 1.34% | 1.66% |
| | Total | 1.28% | 1.66% |

Note: * - includes gas, fuel oil and electricity
Source: Statistics Canada, Catalogue 31-203-XPB

efficiency is using steam generation and fuel consumption data. Measure steam flow and fuel flow over a set period (i.e. 1 hour) and convert steam and fuel flow to identical energy units (i.e. BTU or kJ). The efficiency is calculated using the following equation:

$$\text{Efficiency} = \frac{\text{Steam Energy}}{\text{Fuel Energy}} \times 100$$

For boilers fired by natural gas the following equations can be used:

$$\text{Efficiency} = \frac{\text{lb/hr steam}}{\text{m}^3\text{/hr natural gas}} \times 2.83$$

$$\text{Efficiency} = \frac{\text{lb/hr steam}}{\text{ft}^3\text{/hr natural gas}} \times 100$$

$$\text{Efficiency} = \frac{\text{kg/hr steam}}{\text{m}^3\text{/hr natural gas}} \times 1.28$$

Typically boiler efficiency is in the range of 60-80%. A high efficiency boiler may be able to achieve an efficiency of 85%.

### 5.1.4 Other Energy Benchmarks

Other useful benchmarks to assess energy performance are:

- Annual Natural Gas Use ($m^3$) per Square Metre of Production Area
- Annual Natural Gas Use ($m^3$) per unit of production
- Total Annual Energy Cost ($m^3$) per unit of production
- Total Annual Electricity Use in Kilowatt Hours per $100,000 in Sales
- Total Annual Electricity Use in Kilowatt Hours per unit of production

Although data is not available in order to calculate the median benchmark for the sector, these benchmarks may be useful in tracking a company's performance from year to year.

## 5.2 WATER USE

As stated in section 4, there is limited data available that summarizes water use for the sector. Therefore it is not possible to calculate reasonable benchmark values with this data. The following benchmarks are recommended for use by individual companies so that they can track their performance from year to year.

- Total Annual Water Cost as a Percentage of Sales
- Total Annual Water Cost as a Percentage of Operating Costs
- Annual Water Use ($m^3$) per $100,000 in Sales
- Annual Water Use ($m^3$) per man-hour - for a typical factory the average is 11.8 litres per man-hour
- Annual Water Use ($m^3$) per unit of production

## 5.3 Residuals Generated/Released

There is limited data available that summarizes quantities of residuals generated/released for the sector. Therefore it is not possible to calculate reasonable benchmark values with this data. The following benchmarks are recommended for use by individual companies so that they can track their performance from year to year.

- Tonnes of Solid Sludge Generated per $100,000 in Sales
- Tonnes of Solid Sludge Generated per unit of production
- Hazardous Waste Disposal Costs per $100,000 in Sales
- Hazardous Waste Disposal Costs per unit of production
- Tonnes of Solid Waste Generated per $100,000 in Sales
- Tonnes of Solid Waste Generated per unit of production
- Solid Waste Disposal Cost per $100,000 in Sales
- Litres of Solvent Used per $100,000 in Sales
- Litres of Solvent Used per unit of production
- NPRI reported tonnes per year

## 5.4 Substances Released in Effluents

There is limited data available that summarizes quantities of substances released in effluents for the sector. Therefore it is not possible to calculate reasonable benchmark values with this data. The following benchmarks are recommended for use by individual companies so that they can track their performance from year to year.

- Cubic Metres of Wastewater Generated per $100,000 in Sales

- Cubic Metres of Wastewater Generated per unit of production
- Average BOD loading to Sewer (Model Sewer Use By-Law Limit is 300 mg/L)
- Average Oil and Grease loading to the Sewer (Model Sewer Use By-Law Limit is 15 mg/L for synthetic oils and 150 mg/L for animal or vegetable oils)
- Average Suspended Solids loading to the Sewer (Model Sewer Use By-Law Limit is 350 mg/L)
- Cost of Sewer Surcharge per $100,000 in Sales
- Cost of Sewer Surcharge per unit of production
- Cost of Wastewater Treatment per $100,000 in Sales
- Cost of Wastewater Treatment per unit of production
- Cost of Wastewater Treatment per cubic metre treated

# 6.0 GENERIC OPPORTUNITIES FOR RESOURCE CONSERVATION, POLLUTION PREVENTION AND SOURCE REDUCTION, AND COST SAVINGS

The following sections provide information on opportunities for resource conservation, pollution prevention and source reduction. Generic information on the opportunity, potential costs savings, equipment costs have been included as appropriate. It should be noted that site specific investigation of any option is required prior to implementation at an individual facility.

## 6.1 PROCESS IMPROVEMENTS

### 6.1.1 Closed-Loop Drying Systems

A new product on the market is a closed-loop drying system that operates on dehumidification principals as opposed to the more commonly used evaporative systems. Unlike heat based dryer systems, this closed loop drying system does not require exhaust or air makeup, nor does it add heat to the material being dried on surroundings and the waste water removed is recovered for reuse. Although this is a relatively new technology, nine systems have been installed at Ford, four at Honda and three at Toyota. Advantages include low electrical requirements, lower space requirements, low temperature, and lower capital cost. This system is applicable for the removal of water from manufactured components including:

- water washed components drying;
- water based paints drying; and
- sludge drying.

Based on information provided by HYGREX™, typical costs of using a conventional dry-off oven rated at 1 MMBTU/hr is $6/hr. In a similar 10 kW unit the cost would be as low as $0.50/hr. Ford has reported that their energy costs are 1/6$^{th}$ of a conventional system.

### 6.1.2 Hydroforming

Hydroforming is a new manufacturing process that starts with a straight or bent, welded, round tube that is placed in a forming die. The tube is then filled with fluid at sufficient pressure to force the tube to conform to the shape of the die cavity. This emerging technology can produce tubing that is ideal for car sub-frames, structural parts such as engine cradles, radiator surround/support, lower and upper longitudinal body rails, instrument panel support beams, steering column energy absorption bellows, D-pillars for station wagons, and various body cross members.

The benefits to hydroforming over conventional stamping are reduced tooling costs, improved dimensional accuracy, less or negligible die wear, elimination of weld flanges, reduced weight, and increased strength and stiffness. Environmental benefits include reduced use of die lubricants and reduced energy costs.

## 6.2 ENERGY

There are numerous well documented and demonstrated measures to reduce energy consumption and improve overall efficiency. The following provides a summary of the available opportunities.

### 6.2.1 Boiler Operation

- **Repair Steam Leaks** - Steam leaks not only waste energy, but also result in water loss and a resulting increase of usage in water treatment chemicals. All facilities that use steam for process or space heating should implement a program of regular steam trap inspection and maintenance. A single steam trap, leaking 100 psig steam through a 1/16" orifice, will lose approximately 13 pounds of steam per hour. Using a price of $10/1000 lbs, the cost of this single leak is $1,140/year. The cost to repair the trap would be typically less than $100. The simple payback is 0.09 years or 1 month.

- **Improve Boiler System Efficiency** - Improved boiler system efficiency involves reducing heat losses from the entire boiler system. In terms of costs, a facility that has an average steam generation rate of 10,000 lb/hr and an efficiency of 65% would pay $41,000 more in annual natural gas costs than a similar facility with a boiler efficiency of 70% ($0.15/$m^3$ natural gas). For a high efficiency boiler with a 85% efficiency, the annual savings over the 65% efficiency boiler would be $127,000. The heat losses are due to flue gas heat loss, fouling of heat exchange surfaces, loss of heat in hot blowdown water and loss of hot condensate from the system.

  Flue gas heat loss can be reduced by ensuring that the quantity of excess air used in the boiler is optimized so that the unit is operating at maximum efficiency. Reducing excess air by 10% reduces flue gas temperature by 2.5% and increases efficiency by 1.5%. Using the same scenario as above, the savings would be $13,000 annually. A qualified burner technician should be used to properly adjust the burners and combustion air dampers over the boiler operating range.

Other methods to improve boiler efficiency are periodic removal of soot and scale from the heat exchange surfaces and optimizing blowdown of boiler water to minimize energy loss and chemical costs. In some applications a flue gas economizer can be used to recuperate some of the exhaust gas heat loss. Typically a flue gas economizer can improve the overall system efficiency by 3-5%.

- **Insulate Condensate Return Piping and Fittings** - The following calculations were performed assuming an average natural gas cost of $3.92/GJ ($4.16/MMBTU) and a thermal efficiency of 70% for the boilers. For a temperature differential of 50°C (122°F), the estimated annual cost of the heat loss was $67 per metre for an uninsulated 15.2 cm (6 inch) line. Under the same conditions, the estimated annual cost of the heat loss was $42 per metre for an uninsulated 10 cm (4 inch) condensate line. Based on an estimated cost of insulation of $15 per metre, the payback is less than one year.

- **Insulate Chilled Water Return Lines** - The following calculations were performed assuming an average electrical energy cost of $0.05/kWh ($14.64/MMBTU) and a thermal efficiency of 50% for the chillers. For a temperature differential of 10°C (20°F), the estimated annual cost of the heat loss was $67 per metre for an uninsulated 15.2 cm (6 inch) chilled water return line. Under the same conditions, the estimated annual cost of the heat loss was $40 per metre for an uninsulated 10 cm (4 inch) chilled water return line. Based on an estimated cost of insulation of $15 per metre, the payback is less than one year.

- **Investigate Cogeneration** - For large consumers of electricity and steam, the use of cogeneration technology to replace these services should be considered. Unfortunately, a detailed feasibility study must be conducted to investigate different cogeneration schemes, estimates of capital and installation costs, energy savings, operating costs, and return on investment is required. The use of Energy Service Companies (ESCOs) or third party financing may be possible for large scale projects.

- **Install a More Efficient Boiler** - Natural gas fired boilers are currently available on the market that are capable of achieving an efficiency of 85%. Miura Boiler Co. of Brantford has a boiler on the market that is not only 85% efficient but produces low $NO_x$ emissions. When two of these boilers (200 BHP) were installed at Ford's Central Office Building, independent testing showed them to be 8.1% more efficient than the existing boilers. The boilers are available is sizes 50 to 300 BHP for both steam and hot water. To date several plants have had these boilers installed including two at Ford, thirteen at Chrysler, and two at A.G. Simpson.

- **Replace Fuel Oil or Bunker C with Natural Gas** - Natural gas is a clean burning fuel that results in fewer emissions to the atmosphere. Replacing other fossil fuels with natural gas will result in a reduction in air emissions. The barrier to conversion to natural gas is the capital cost and the potential

increased fuel costs for natural gas. Assuming a price of $0.12/litre for Bunker C the cost per million BTUs is $3.17. A similar calculation for natural gas assuming a price of $0.18/m$^3$ results in a cost of natural gas per million BTU of $5.10. In a conversion the higher fuel costs are offset by improved efficiency of newer equipment, removal of risk associated with fuel storage tanks, and reduction is maintenance requirements for new equipment.

### 6.2.2 Electrical Systems

- **Conduct a Lighting Survey** - A lighting survey is useful to identify lights that can be turned off when not required and areas that are overlit. Retrofitting existing lighting with low wattage, energy efficient fluorescent, halide or high intensity discharge lamps is generally cost effective. The benefits of reduced energy usage in lighting systems include reduction in consumption and demand charges for electricity and a reduced load on air conditioning systems. Typically the payback for implementing savings measures (i.e. replacing incandescent lighting, installing T-8 lights, etc.) is in the range of 1.5 to 2.5 years.

- **Investigate the use of Variable Speed Motors and Drives** - For applications where the load fluctuates, the use of a variable speed drive on the pump will reduce energy consumption. The use of variable speed motors and drives requires thorough investigation to ensure that the equipment is adequately sized and appropriate for the application. At one facility the payback for installing adjustable-speed drives on two motors (25-hp and 20-hp), was estimated to be 2.3 years.

- **Reduce Peak Demand** - Included on electrical bills for most industrial facilities is a charge for peak electrical demand. The peak electrical demand is based on the highest demand that occurs during the peak hours in the billing period. In order to reduce the peak load there are three options, load shedding, load shifting and generally reducing power requirements. In load shedding non-essential equipment is shut off during the peak period. Load shifting involves rescheduling activities so that they take place during off peak times. In terms of costs, a facility with a 1000 kW peak monthly demand would pay approximately $12,000 monthly in demand charges (based on a cost of $12/kW). A reduction of 10% in the peak demand would result in an annual savings of $14,400.

- **Improve Power Factor** - A low power factor is usually caused by inductive loads such as transformers, lighting ballasts and AC induction motors. On utility bills, power factor penalties are usually assessed on consumers whose power factor is less than 90%. A simple review of your current electrical bill should identify whether you are paying a penalty. The billed kW demand is the lesser of the actual peak kW demand or 90% of Peak kVA demand.

  As a demonstration, consider a facility that has an peak monthly demand of 5000 kW. If the power factor is above 90%, the monthly cost for demand using a cost of $12/kW is $60,000. With a power factor of 85% the monthly cost increases by 6% to $63,530. The additional annual cost due to the poor power factor would be $42,355.

Correcting the power factor generally requires using an electrical consultant to review the electrical loads and determine where capacitors should be added to bring the power factor back above 90%. The payback for correcting the power factor is normally in the range of 2 to 3 years.

- **Electrical Bill Analysis** - there are many different rate structure that are used by utilities for billing purposes. Most industrial and commercial facilities are billed for electricity use according to a General Service Rate schedule in which the customer pays for the peak electrical (kW) and energy consumption (kWh). Most General Service rate structures also include a financial penalty for having a poor power factor as discussed above.

  Most areas have a time of use rate for large consumers whose peak demand exceeds 5,000 kW. Time of use rates offer very low off-peak rates to induce customers to shift operations to off-peak times of the day. Undertaking a review of the electrical bill should assist in identifying in the most beneficial rate structure is being used and the potential benefits to changing some operations to off-peak hours.

### 6.2.3 Compressed Air

- **Reduce Air Leaks** - Most industries that use compressed air have leakage rates in the range of 10 to 20%. A pinhole leak (1 mm) on a system with a working pressure of 600 kPa (gauge) costs approximately $10/month. A leak that is 5 mm in diameter on the same system costs approximately $298/month. A review of compressed air losses for an APMA member facility with a capacity of 2160 cfm, showed air losses were costing the firm in the range of $25,000 annually. Identifying air leaks is easily done with the use of handheld ultrasonic leak detectors. These units work by detecting the high pitch noise given off by escaping air. The advantage to these units is that they can detect the high pitch noise given off by leaks even when the working environment is very loud and thus can be used during normal working hours. The purchase price of an ultrasonic leak detector is in the range of $1,500 to $6,000.

- **Install Automatic Shutoff** - Each individual production machine should have only one source for the supply of compressed air. Each supply point should be provided with an automatic shutoff valve interlocked with the start/stop controls at each machine. Where this method is impractical or not cost effective shutoff valves can be installed at main air headers for remote operation from the powerhouse.

- **Install Flowmeters** - Consideration should be given to installing flowmeters for key air consumers to improve accountability for air consumption.

- **Compressed Air Operating Mode** - In some cases switching the operating mode from the modulation control mode to the on/off control mode and installing receiver capacity can result in a corresponding reduction in energy consumption. At one auto parts facility the energy savings was estimated to

be $9,300 annually. With a capital cost for the receiver of $15,000 the resulting payback was 1.6 years. In addition, there are also some new software programs on the market designed to improve compressor control and thus reduce operating costs.

- **Install Compressed Air Nozzles** - The installation of high efficient compressed air nozzles will reduce compressed air losses by 60%. As an example, a ½" pipe at 90 psi, will consume approximately 375 SCFM of compressed air. Installing a high efficient plastic nozzle at a cost of $20.00 will reduce compressed air down to 117 SCFM (65%). The savings associated with this application, assuming the compressed air losses are occurring 24 hours/day 5 days/week would be equivalent to $12,400/year.

- **Install Control System** - The installation of a control system can reduce energy usage by optimizing the compressed air system and identifying deficiencies in the system. Sarlin Balance, through Goodfellows Consultants (905-858-4424), has a control system available for large users of compressed air and reports that its system typically reduces energy costs by 20-30%.

### 6.2.4 Cooling Towers

Cooling towers are designed to cool process water by evaporating water in contact with air. The heat required for evaporation results in a drop in the water temperature. The most common cooling towers are mechanical draft cooling towers that use fans to move the air instead of depending on natural draft or wind. Cooling fans increase the cooling process and efficiency of the tower by increasing the air velocity over the droplets of water falling through the tower. The efficiency of a cooling tower is effected by the following items:

- temperature gradient
- scaling
- blowdown frequency
- **Increase Temperature Gradient** - The driving force in a countercurrent cooling tower is the temperature differential between the incoming and outgoing cooling water. Decreasing the flow of water and operating at a high temperature gradient will increase overall system efficiency.

- **Reduce Scaling** - Like any heat transfer surface, scaling reduces overall system efficiency. Keeping scaling to a minimum will ensure that the system is operating efficiently.

- **Reduce Blowdown Frequency** - While blowdown is a requirement to reduce the build up of materials in the cooling water, it also results in a loss of efficiency, requires additional makeup water and chemicals to treat the new water. The blowdown frequency should be optimized to ensure that it is only conducted when necessary. At many sites the blowdown is done based on a

rigid schedule rather than when it is required by the system, this results in increased operating costs.

### 6.2.5 Chilled Water

Many chillers used to produce the chilled water required for plant operation use CFCs. Due to the effects of CFCs on the ozone layer the manufacture of these compounds was banned in 1996. To respond to the depleting supplies of CFCs, increasing purchasing costs, and to reduce the environmental impacts of CFCs there are three options available. They are to:

- contain the refrigerant in the existing chillers using specialized containment devices;
- convert the existing chiller to utilize and contain an alternative refrigerant; or
- replace the existing chillers.

These options are discussed in detail below.

- **Containment of CFCs in the Existing Chillers** - Generally, if a low-pressure chiller is less than 15 years old and in good working order, containment may be the most economical solution. Containment products are available to reduce the amount of refrigerant lost during the purge cycle and to alarm when condenser pressure increases. The total cost to install the containment and control systems on two machines is $26,000.

    - Under normal operating of a low pressure chiller, air leaks into the system and results in decreasing efficiency of the chiller. This air collects in the condensing unit along with some refrigerant and is purged from the system to improve the operating efficiency of the unit. To reduce the amount of refrigerant lost during the purge cycle, a high efficiency purge can be installed. The costs of a high efficiency purge is approximately $8,000 installed per machine.

    - Catastrophic failures of low pressure chillers with resulting loss of refrigerant are not common because of the low operating pressure. However, failure can occur if the unit is overheated and a build up of pressure occurs. An alarm system is available that is based on the condenser pressure that alerts the operators of any increase in pressure before a failure occurs. The cost of the alarm system is approximately $5,000 installed per machine.

- **Conversion of Existing Chillers to Non-CFC Refrigerants** - Conversion of positive-pressure chillers to use HFC-134a is possible. The costs of the conversion of a positive pressure chiller is typically half of the price of a new chiller. Negative-pressure chillers can be converted, however, the cost is prohibitive. The conversion costs are typically about 80% of the price of a new chiller.

- **Replacement of Existing Chillers** - Currently replacement chillers use three technologies; negative pressure; positive pressure; and absorption. In negative-pressure chillers the only current alternative refrigerant is HCFC-123. Although HCFCs are preferable to CFCs, they still result in ozone depletion and are scheduled for phase out. Positive-pressure chillers can use HCFC-22 as well as the chlorine free HFC-134a. Absorptive chillers use water as a refrigerant to absorb heat from the building's chilled water system and thus are CFC free. The replacement of an older 500 ton chiller with a new 500 ton chiller using non CFC H-134a at one facility resulted in an annual savings in electrical cost of $60,000 due to the increased cooling efficiency. The payback for this installation was in the range of 3.1 years.

### 6.2.6 Other Energy Savings Measures

The following are some additional energy saving measures that may result in further energy conservation.

- **Set Back Temperatures** - For plants that operate less than 24 hours per day, 7 days per week, energy savings can be achieved by reducing the temperature in plant area that are not in use. Even in plants that operate 24 hours per day it may be possible to use set back temperatures in the administration offices. The costs for implementing a simple control system are minimal.

- **Spray Booth HVAC Shut Down** - typically paint spray booth air make up units are large consumers of natural gas and electricity. During off-shifts when painting is not occurring the air make-up rate/exhaust rate should be reduced to save energy costs.

### 6.2.7 Energy Use Monitoring

The measuring, metering and monitoring of energy in a facility is essential in the effort to reduce energy use. The information identifies large energy consumers, establishes the priorities for energy savings initiatives, allows comparison before and after implementation of a savings measures, and provides information about the processes taking place. Some of the most useful measurements are flow (steam, water, electricity, fuel), temperature, voltage, and current.

## 6.3 WATER

Water efficiency opportunities are detailed below in Sections 6.3.1 and 6.3.2 for sanitary uses and process areas, respectively. A few key items that can assist in identifying and minimizing water use for both areas include:

- **Install flow meters** - Consideration should be given to installing flowmeters for key areas of consumption to improve accountability.

- **Conduct regular maintenance** - on all water using equipment and water piping etc. is required to maintain operational efficiency and minimize leaks.

### 6.3.1 Sanitary Water Conservation Measures

Every industrial facility has a number of sanitary water fixtures such as toilets, urinals, showers, and lavatory faucets. Some opportunities for reducing water use include:

- **Install water efficient shower heads**: Standard fixtures can use in excess of 20 litres per minute of water. Depending on the frequency and duration of showers, a water efficient model with a flow rate of 9.8 litres per minute can have a payback of less than one year. Energy costs are also reduced as less water needs to be heated.

- **Install faucet aerators**: Faucet aerators can reduce the flow rate from in excess of 20 litres per minute to less than 8 litres per minute and cost less than $10 installed for a payback period of less than one year. Alternatively, a metering faucet can be installed (closes after several seconds) however higher capital costs result in longer payback periods. Electronic motion detection faucets are generally not cost effective unless installed in areas of extremely high usage.

- **Install hose nozzles**: Unattended hoses with continuous flow can waste 30 litres of water per minute (approximately $25 to $50 per day). All hoses should be equipped with a trigger nozzle to permit better control of the spray pattern and prevent the water being wasted when the hose is unattended by an operator. At <$50, a hose nozzle has an immediate payback.

- **Adjust or replace toilets to use less water per flush**:

  - Toilet retrofit kits can improve the efficiency of older, high-volume flush toilets by reducing the flush volume by anywhere from 2 to 5 litres/flush. These products are only recommended for tank-type toilets. They are inexpensive (approximately $20/toilet) and are relatively easy to install. Care must be taken to ensure that the toilet will continue to operate properly; an adjustable type device should be purchased so that the product can be adjusted to the characteristics of your particular toilet.

  - Replacing existing non-efficient units with ultra-low flow (ULF) water closets will save 7 to 13 litres per flush. Pressure-assist or vacuum-assist type ULF toilets are generally recommended. Gravity-type ULF toilets are less desirable as they are more prone to inadequate flushing and may require the water used per flush to be increased to obtain satisfactory performance.

  - Flush-valve type toilets can be adjusted to provide more or less water per flush. Water pressure, bowl design, and downstream conditions can all affect the performance of a water closet; the flush valve should be adjusted, if possible, to use the minimum volume of water while providing a good quality flush. Although there is no hard and fast way of determining the efficiency of flush valves, a simple rule is, "Unless the

valve is using obviously too much flow, let it go". Adjusting the flow usually requires only the use of a screw driver or wrench and takes only a few minutes.

- Alternatively, the flush-valve can be replaced with a water efficient model.

- Approximately 1/3 of toilets have leaking flapper valves that can easily waste 500 litres per day. Drop a dye tablets or liquid food dye into the toilet tank. After approximately 15 minutes inspect the water in the bowl - the presence of colour indicates a leaking flapper. Flappers cost only about $3.00 and are easy to change.

### 6.3.2 Process Water Conservation Measures

**Cooling Towers**

Water make-up to cooling towers typically accounts for a large percentage of the total water consumption of any industry, including the auto industry (e.g., 19% of water consumption at one auto parts facility over a three month period). Make-up water is added to the cooling tower systems to compensate for losses through evaporation, drift and bleed-off (blow-down). Evaporative losses cannot be controlled easily and account for approximately 9.6 to 12.5 litres per minute per 100 tonnes of cooling (2.3 to 3 U.S gpm per 100 tons) (Ref: "A Manager's Guide to Saving Water and Dollars", Conservation Assistance Program, Tucson Water Conservation Office (1993)).

Consumption can be more easily reduced by reducing the amount of bleed-off, which results in a higher concentration ratio or water use efficiency. Chemicals are often used to treat recirculating cooling tower water to control potential damage from a buildup of minerals or other impurities present in the recirculating water. Chemical vendors should commit to a predetermined performance standard which takes into account control of corrosion, scale and biological fouling to ensure cooling towers are operating at optimum water efficiency.

More recently, non-chemical process are being marketed for the treatment of cooling tower water. One such system is the electrocel technology system called "Electrosci System" distributed in Canada by World Wise. It uses a non-chemical electrolytic process to destroy biological growth and organic contaminants and claims to significantly reduce scale build-up and inhibit corrosion, thereby increasing water efficiency. The process involves the aspiration of oxidant gases into the cooling water system.

Another potential water conservation measure involves the use of other sources of water in the plant which could be used as make-up water if available in sufficient quantities and of suitable quality.

**Parts Cleaning**

Parts cleaning can utilize large quantities of water and chemicals, particularly if operated as a batch process. The addition of a recycle loop can result in savings in water as well as reduced chemical consumption. Membrane technologies are commonly used to clean washwater of soluble solids and to increase recirculation. An example is the ultrafiltration system connected to the dip tanks at one automotive parts facility which are used to recycle water and cleaner and to remove and concentrate oils and other contaminants in a separate tank for disposal.

Other initiatives to reduce water consumption in parts cleaning include:

1. conversion to high pressure wash systems;

2. use of countercurrent rinse methods where water flows in the opposite direction from the process sequence; the final rinse tank receives fresh water and preceeding tanks use water from the subsequent tanks; this can reduce water consumption by as much as 50%;

3. evaluation of alternative cleaning agents;

4. replace baths with spray rinses if product quality can be maintained;

5. use timers and conductivity controllers to control quality of water in rinses;

6. investigate sequential rinsing methods where spent rinse water from one process is used as rinse water for another compatible process rinse; and,

7. eliminate single-pass uses of water where possible; for example, degreasers and welding machines often use once-through cooling water; these technologies could be modified to operate using a closed loop cooling system.

## 6.4 CHEMICALS

The following section provides some examples of methods of reducing or eliminating various chemicals from automotive plants.

### 6.4.1 Management of PCBs

Legislation currently allows for the use of equipment containing PCBs. However, when electrical equipment is taken out of service it should be checked for PCB content. Equipment containing PCBs must be stored in govemment approved PCB storage facilities.

- **Remove PCB Electrical Equipment** - This lowers the risk of release of PCBs into the environment and lowers the risk of PCB related emissions in the event of a fire in the plant. Out of service PCB electrical equipment (i.e. oils,

transformers, capacitors, light ballasts, etc.) can be destroyed at the approved Chem Security Alberta Limited destruction facility in Swan Hills, Alberta or at an approved destruction facility in the United States. A number of Ontario brokers can be retained to ship the PCB electrical equipment to the approved facilities. There are also future plans through a joint venture between Toronto Hydro and a ELI Eco Logic Inc. ("ECO LOGIC") to process PCB-contaminated materials in Toronto using ECO LOGIC's patented mobile non-incineration technology. This project will consolidate and destroy PCBs in Toronto owned by Toronto Hydro, the City of Toronto and other public and private organizations.

### 6.4.2 Selection of Non-Production Materials

When selecting non-production materials, an emphasis should be placed on environmentally friendly products. Materials should be chosen so that use of lead, phenols, solvents and other chemicals are minimized.

- **Eliminate use of Lead in Greases** - Greases containing lead can be replaced with alternate metals and graphite compounds. Suppliers can assist in identifying appropriate replacement materials that do not contain undesirable chemicals. Care must be taken to ensure through testing that the replacement material will be able to achieve the quality and performance standards of the original material.

- **Eliminate Phenol in Cutting Oils** - Typical cutting oils for turning aluminum pistons contain 3% phenol substances. Therefore the waste oils, sludges and turnings contained quantities of phenols. Reformulated cutting oils which are phenol-free can be identified by the suppliers which can meet the machining requirements. Elimination of phenol containing cutting fluids reduces the amounts of phenol containing waste oils and sludges each year. As phenol is a NPRI reportable compound, its elimination will reduce reporting requirements.

- **Elimination of Phenol in Casting** - Ford's Windsor Aluminum Plant was using an adhesive as a mold bonding agent which contained phenol. Ford changed to a Cosworth system which is a sand casting process where the molds are made of Zircon sand imported from Australia. More than 98% of the Zircon sand is processed and reused and the remainder is a saleable product for use in another industry. All handling equipment uses dry processes and therefore, no process water is generated. The sand is thermally treated to destroy the phenolic resin binder so that the sand is released from the cast. The process results in a higher casting quality and clean reusable sand. No phenol is released to the wastewater or as a part of the sand waste. These changes resulted in higher quality casting, no wastewater generation, and reduced costs associated with sand purchasing and wastewater treatment

- **Eliminate Zinc in Hydraulic Oil** - Zinc is often used as an antiwear additive in hydraulic oil. Unfortunately some of the oils leak into the cooling system which degrades the coolant emulsion. The degradation in the coolant is attributed solely to the zinc. Coordination with the vendor can identify

substitute zinc-free hydraulic oils which will be suitable in the hydraulic system. It is possible to substitute the zinc hydraulic oil with a compatible zinc-free hydraulic oil so that no purging of the existing hydraulic tanks is necessary.

- **Eliminate use of Hydrochloric Acid and Caustic in DI Water Production** - Large amounts of caustic and hydrochloric acid are used by ion exchangers in the manufacture of deionized water for use in the painting phosphating process to clean the parts and eliminate any surface impurities which may later cause corrosion. If the acid is not sufficiently neutralized it may result in corrosion of concrete sewer line and manholes. In addition, there may be difficulties in handling and storing of hydrochloric acid and caustic. To alleviate this problem a reverse osmosis (RO) system can be installed which uses a membrane for water purification instead of chemicals.

- **Eliminate use of Methylene Chloride** - Methylene chloride, which is a chlorinated solvent that used as a paint stripper, can be replace by more environmentally friendly strippers. At Chrysler's Windsor Assembly Plant, a replacement cleaner was developed that was compatible with the paint lines, was easier to recycle, resulted in cleaner lines, lower disposal costs and cost savings. The Cobra Line Cleaner was developed by Gage Products and contains inert particulate additives which are very effective in cleaning paint lines.

- **Reduce Solvent Based Adhesives** - Solvent based adhesives can be replaced with alternate adhesives. For example, solvent based adhesives used for gluing of interior door panels to door liners can be replaced with alternate adhesives. This reduces VOC emissions and reduces worker health and safety concerns.

- **Replacement of Oil Based Drawing Materials** - New drawing compounds are currently available that are more environmentally friendly than oil based materials. One compound, Ameriform, is reported by its manufacturer to reduce frictional heat by 50%, extend tool life by 5 to 10 times, eliminate galling and leave a clean and dry finish. Ameriform is available in Canada from Rochester Midland (1-800-387-7174).

### 6.4.3 Elimination of Ozone Depleting Substances

There are several provincial and federal regulations that restrict the use of ozone depleting substances. As a result it has become necessary to replace many materials containing ozone depleting substances with newer more environmentally friendly products. In many cases the original product is also no longer available. The following describes some of the available alternatives for various operations.

- **Eliminate use of 1,1,1-Trichloroethane as a Mold Release Agent** - At Ford Motor Company of Canada a water-based poly-siloxane emulsion with no volatile organic compounds was found to be a suitable replacement for

1,1,1-trichloroethane. The use of the new mold releasing agent resulted in cost savings as the replacement material was less expensive.

- **Eliminate use of 1,1,1-Trichloroethane as a Cleaner** - 1,1,1-trichloroethane which is used as a cleaner was substituted at the General Motors facility to a water based cleaner thereby eliminating the emissions of ODSs from the use of the 1,1,1-trichloroethane.

- **Eliminate use of 1,1,1-Trichloroethane in Halogenated Solvents** - Halogenated solvents containing 1,1,1-trichloroethane can be replaced with a solvent containing 100% petroleum naphtha. The replacement solvent has much higher flashpoint, a lower evaporation rate which reduces odours and emissions and contains no ODSs. At the Ford Motor company it was found that the replacement frequency was approximately 50% lower than the previous solvent, resulting in lower worker exposure, paperwork and waste disposal costs. The disadvantage to the 100% petroleum naphtha solvent was that the parts being cleaned required a longer drying time.

- **Replacement of Cleaning Solvents** - Replacing cleaning solvents with alternative non-hazardous (high flash-point) cleaning solvents, reduces the generation of hazardous wastes containing ethylbenzene, toluene, 1-1-1, trichloroethane and perchloroethylene. This in turn results in an elimination of hazardous waste manifesting requirements, and reduces the health and safety concerns regarding the handling of the hazardous material.

- **Selection of Alternative Solvents** - The US EPA has developed a comprehensive Solvent Alternative Guide (SAGE) designed to provide pollution prevention information on solvent and process alternatives for parts cleaning and degreasing. The guide is available free for use on the Internet or for downloading. The guide evaluates a process based on the user's responses to a set of questions including questions on the physical properties of the part, current cleaning operations, level of cleaning required, etc. The form is simple to use with most questions require only a yes or no response. It then provides a list of ranked alternatives with links to more information about those alternatives. The guide is available on the Internet at "http://clean.rti.org".

## 6.5 PROCESS RELATED RESIDUALS

### 6.5.1 Wastewater

As previously noted, wastewater is generated from foundry operations (metal laden waste), painting (wet scrubbers), parts and solvent cleaning (oil, dirt, acid/alkaline wastes, oily water). A combination of continuous and batch wastewater generation produces wastewater of highly variable characteristics. Wastewater treatment systems are required to remove any or a combination of: settleable and floatable materials, acid/alkaline wastes, emulsified oils, BOD and heavy metals.

There are a wide range of treatment technologies that can be applied to treat wastewater containing heavy metals and oils and grease, including any of a combination of:

- Pre-treatment: gravity interceptors, flow equalization, pH adjustment, oxidation (i.e. ozonation);
- Chemical precipitation: coagulation/flocculation and solids separation (gravity settling or air flotation);
- Biological treatment: various configurations of the activated sludge process are available;
- Solids polishing: conventional filtration, ultra-filtration, nano-filtration, reverse osmosis; and
- Complex or specialized treatment: electrolytic processes, electrodialysis, ion exchange, dissolved air flotation.

The treatment process generally includes a number of these types of unit processes in series. Demulsification of oils and grease generally require acid addition; precipitation of metals require alkaline conditions. The most suitable, cost-effective treatment process is determined by site specific waste characteristics including wastewater volume, contaminant concentrations, and hydraulic variability, and effluent requirements such as sewer use by-law contaminant limits. The cost of treatment is a function of the system size and the number and complexity of unit processes required to produce the required effluent quality.

Examples of treatment process trains:

- interceptor to provide gravity flotation and sedimentation (volume and wastewater pumping to downstream processes also provides some measure of flow equalization);
- pH adjustment using sulphuric acid and demulsification of oil and grease with demulsification polymer;
- coalescing plate separator to collect and remove oils;
- lime coagulation, polymer addition; and
- gravity settling tanks in series to remove solids.

Table 6.1 provides a summary of treatment processes and their uses.

**TABLE 6.1**
**SUMMARY OF WASTEWATER TREATMENT METHODS**

| PROCESS | DESCRIPTION | SUITABLE FOR | COMMENTS |
|---|---|---|---|
| Gravity Interceptors | • gravity sedimentation and floatation | • heavy solids and non-emulsified oil and grease | • inexpensive form of pre-treatment<br>• extremely common |
| Flow equalization | • storage tank to minimize hydraulic variations to the treatment facilities | • wide fluctuations in hydraulic loading to treatment system | |
| pH adjustment | • addition of acid or caustic materials | • pH to 3 to demulsify oils | • common pre-treatment component of conventional treatment system<br>• polymer addition improves demulsification<br>• often used as post-treatment to adjust pH to by-law limits |
| Ozonation | • oxidation process | • organo-metal complexes release metal ion which can then be removed by chemical precipitation | • versatile process can readily oxidize wide variety of organics and inorganics |
| Coagulation/ Flocculation | • addition of flocculating agents (i.e. alum) and coagulants (polymer) to precipitate metals | • metals, suspended solids | • common component of conventional process |
| Gravity settling | • clarifiers, inclined plate settlers, settling ponds | • removes flocculated materials | • common component of conventional process<br>• generates sludge that requires de-watering and disposal |
| Dissolved Air flotation (DAF) | • floatation of oils & suspended materials to surface by adhering them to small air bubbles | • oil and grease, neutrally buoyant particles | • usually requires pH adjustment and polymer addition to demulsify oils and grease prior to air flotation |
| Biological treatment | • activated sludge process; requires mixing and air to sustain biological growth | • removes dissolved organics; (BOD/COD) and suspended solids<br>• suitable for wastewaters with BOD/COD ratio of 1.5 to <3.0 | • metals can be toxic to the process<br>• requires neutral pH<br>• relatively sensitive to organic and hydraulic load variations |
| Filtration | • wastewater stream passes through filter bed under gravity or pressure | • removes residual solids & associated metals | • generally located downstream of sedimentation processes |
| Ultrafiltration | • pressure driven membrane process | • removes residual solids and associated metals, high molecular weight organic materials such as oils and grease | • improved removals over conventional filtration<br>• higher capital & operating costs than conventional filtration |

**TABLE 6.1**
**SUMMARY OF WASTEWATER TREATMENT METHODS**

| PROCESS | DESCRIPTION | SUITABLE FOR | COMMENTS |
|---|---|---|---|
| Reverse Osmosis | • pressure driven membrane process | • metals (common in plating industry)<br>• high to low molecular weight organic materials | • greater removal than ultrafiltration<br>• high operating pressures but little energy<br>• chemicals can be recovered<br>• additional water is required for backwashing the membrane<br>• high maintenance costs |
| Electrolytic Processes | • plates out metals | • used in electroplating industry for dissolved metals, cyanides, or hexavalent & trivalent chromium, copper, nickel ferro- and ferricyanide complexes | • large power requirements |
| Electrodialysis | • membrene process separates and removes ionic species via an electric field | • metals (nickel, chromic acid) | |
| Ion Exchange | • resin bed selectively removes either cations or anions from solution | • used in electroplating industry to remove trace pollutants after conventional treatment | • low energy requirements and moderate capital cost<br>• spent resin can be regenerated |

### 6.5.2 Solid Waste

Figure 6.1 summarizes the percentage of solid waste which is generated by industry, business and residential sectors. As can be seen, in Ontario, industry is responsible for generating 30% of the solid waste which is sent to landfill. Furthermore, review of the composition of the waste itself within the landfill, Figure 6.2, shows that the majority of the material in landfills is comprised of paper and paperboard followed by yardwaste, plastics, miscellaneous products, metals, wood, food and glass.

The generation and subsequent reduction of solid waste in industrial settings varies significantly from facility to facility. As a general rule waste produced in a manufacturing plant will either be process waste that results from the process itself or general (packaging) waste that suppliers have provided.

#### 6.5.2.1 Determining Total Quantity and Composition of Solid Waste

The first step to reducing the amount of solid waste being generated at a facility is to determine the quantity of waste that is being generated. Although Figure 6.2 shows the make up the average industrial landfill, these figures should be used as a point of comparison for your facility.

The following steps should be followed to determine the total quantity and composition of solid waste:

- **Determine Total Tonnage**

  1 summarize the number of containers & size throughout plant

  2 name of hauler

  3 estimate of the "percent full" when pulled

  4 cubic yards per pull (percent full x capacity of container)

  5 pulls per week

  6 cubic yards per week

  7 tons per week (as determined by hauler or landfill

  8 Total tons per year

- **Determine Composition of Waste** This can be achieved by checking the waste itself, reviewing purchasing data, discussions with suppliers, and a common sense approach. The intention is to provide an estimate of the composition of the waste, therefore estimate the large percentage materials first, and work through to the smallest. Furthermore, the total percentage should fall between 95% and 105% for completeness. The

**FIGURE 6.1**
**SOURCES OF SOLID WASTE**

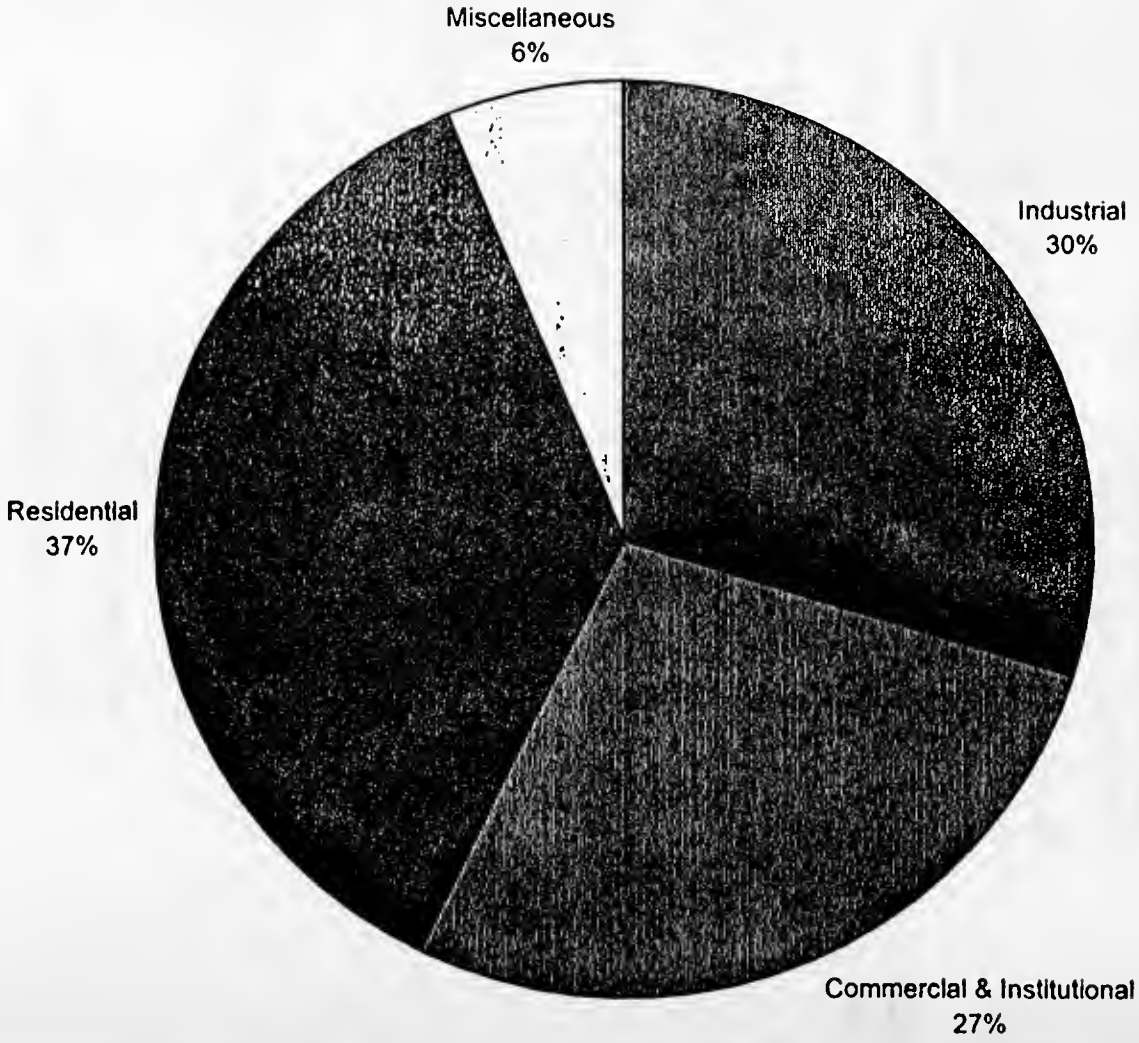
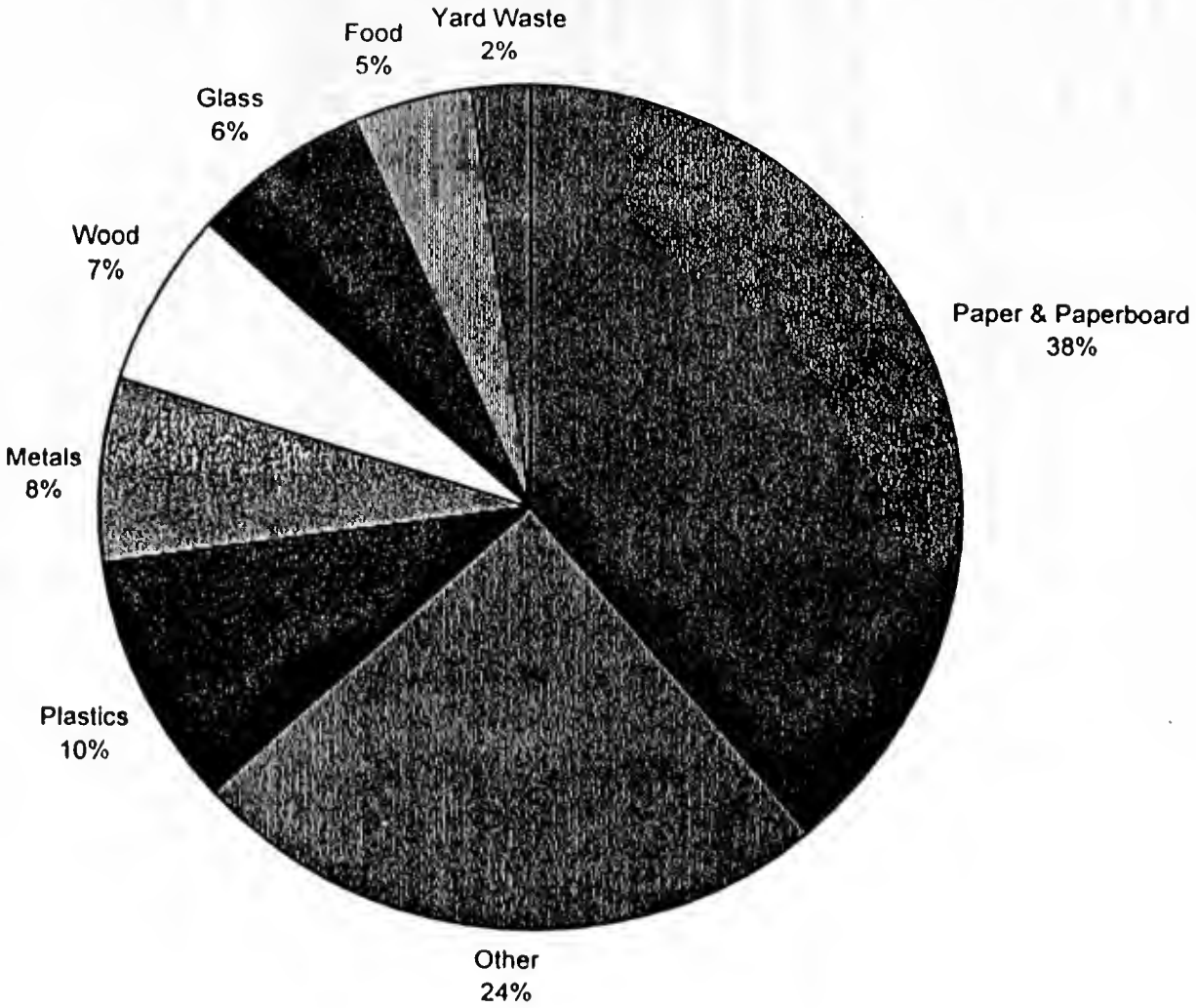


**FIGURE 6.2**
**COMPOSITION OF SOLID WASTE**



following list summarizes the major types of wastes streams which should be considered:

a) paper (general office, computer, and newsprint)

b) cardboard

c) plastics (stretch wrap, PET, HDPE, PVC, LDPE, PP, and PS)

d) wood (pallets, construction, and dunnage)

e) textiles (rags and gloves)

f) metal (ferrous, aluminum, copper, and brass)

g) rubber (cured and uncured)

h) glass (plate, laminated, clear, green, and brown)

i) filters (paint, oil, filter cake and still bottoms)

j) waste oil

k) yard waste (grass/leaves, and brush)

l) food waste

m) other

- **Determining Cost of Waste** is based upon the sum of the disposal cost and the associated costs. The following points highlight the key cost which should be considered.

a) disposal costs

  - container rental
  - pull fee or hauling charge
  - tipping fee

b) associated costs

  - raw material costs
  - labour costs
  - utility costs
  - equipment costs (balers, shredders, etc.)

### 6.5.2.2 Process Wastes Reduction Opportunities

Process wastes, as described above, are defined as wastes which are generated from the manufacturing process itself. Within the automotive parts manufacturing sector these waste are normally made up of metal and plastic cuttings from stamping processes, paint wastes, metal shavings or turnings, filter cake and textile scrap.

Unfortunately, the diversity of industrial processes makes it impractical to address process waste reduction opportunities within the scope of this Sector Guide. However the following points can serve as guides to making process changes:

- Waste reduction and QS 9000 are closely tied together. A good quality program will encourage waste reduction.
- Income from marketing recyclable process waste is always less than the purchase cost of the material.
- Industry has spent a great deal of time and resources perfecting processes therefore there is normally a great deal of reluctance to change. Suggesting process changes normally requires thorough investigation of costs, alternatives and results.

### 6.5.2.3 Waste Reduction Opportunities

General or package wastes, as described above, are defined as wastes which are normally supplied to the facility itself. Within the automotive parts manufacturing sector these waste are normally made up of paper, corrugated cardboard, wood pallets, expanded polystyrene and styrofoam, and scrap metal.

The development of good operating practices and housekeeping is the first step in defining and implementing a solid waste reduction program which can provide substantial economic return, reduce liability, enhance the working environment, increase public perception, conserve resources and reduce a plants impact on the environment.

In particular the best way of reducing the amount of packaging waste is to work with suppliers to reduce the quantity of cardboard, pallets and drums entering your facility.

Recommended waste reduction opportunities include:

**Corrugated Cardboard**: Markets for corrugated cardboard exist throughout Ontario. The value of the corrugated cardboard are dependent upon market demand, condition (no oil, dirt or foreign material), whether it is baled, size of the bale and proximity to the market. At a minimum corrugated cardboard should be broken down and collect it in a dedicated dumpster. Further handling of the cardboard should be considered upon review of the local market. Other options include: baling, dedicated compactor, provide delivery to local recycler, or having

an outside contractor handle and pickup cardboard. Some recyclers will pick-up corrugated cardboard with no cost for disposal.

**Wood Pallets**: Pallets are one of the most common wastes in industry. Reduction of pallets can be accomplished by:

- the use of slip-sheets (where applicable);
- switching to permanent pallets or racks. Since there is a "design" component to this option, the economics of this option should be closely considered;
- back haul or return the pallets to the originator;
- repairing wooden pallets normally costs much less then replacement; and
- pallets made from recycled material are available.

**Office Paper**: The reduction of office paper is one of the most difficult programs to put into place. Within the average work place between 50 and 75 percent of all office paper purchased ends up as waste paper. The development of an office program will ensure that all levels of plant personnel are involved in waste reduction. The specific reduction of office paper waste revolves upon changing peoples habits. Reduction opportunities will normally include: 2-sided printing, more efficient use of e-mail systems, not making "file" copies of all documents which are stored on computer disk, use of obsolete forms or paper already printed on one side for rough drafts or material which will be revised, don't buy paper which cannot be recycled, and buy paper with maximum recycled content.

**Drums**: Most drums, including all sizes of steel, plastic and fiber drums can be replaced by returnable containers. Furthermore, many materials can be purchased in bulk in returnable plastic totes in metals frames.

**Stretch Wrap**: Stretch wrap (plastic film) must be baled for handling by recyclers. A baler suitable for cardboard will normally work for stretch wrap. Most recyclers prefer to handle a minimum of five 1,000 pound bales. Two points to consider is that some floor space will be required to accumulate the stretch wrap and that the stretch wrap must be clean.

## 6.6 GASEOUS EMISSIONS

The following sections identifies methods that can be used to reduce air emissions. The areas focused on include the painting operation, solvent usage, and other process operations.

### 6.6.1 Measures to Reduce Air Emissions from Painting Operations

- **Increase Transfer Efficiency** - Increased transfer efficiency will result in decreased overall paint usage, decreased VOC emissions and lower operating costs. The transfer efficiency is calculated based on the paint

thickness multiplied by the total area to be covered (i.e. quantity of paint required for 100% efficiency) divided by the amount of paint used. The transfer efficiency will be effected by the paint thickness, paint rejects, overspray and part dripping. There are a number of different application technologies each with varying degrees of transfer efficiencies. Application technologies include dip, flow, roller, electrodeposition, spray (air atomized, airless, electrostatic, and HVLP), and electrostatic bell and disk.

- **Convert to Water-borne Coatings** - The application of water-borne coatings is similar to the organic solvent-borne. Thus, the conversion to water-borne coatings does not necessarily require extensive replacement of the existing coating application equipment. Although water is the major carrier, some organic solvents are included to aid in wetting the pigments, to improve solubility and to promote good flow and viscosity characteristics in the coating mixtures. The organic solvent content of water-borne coatings varies between 2% and 15% by volume. The conversion to water-borne coatings reduces VOC emissions and associated solid hazardous wastes. Thorough investigation of this option is required prior to implementation. The costs of the replacement paint may be higher and it has a lower transfer efficiency which increases the product usage. In 1995 Chrysler Canada at the Windsor Assembly plant converted the colour base coat from a high solids solvent borne enamel to waterborne enamel paints. This conversion eliminated over 75% of the solvents associated with this process.

- **Convert to High Concentration Solids Coatings** - As the name suggests, high-solids coatings have a higher solids content and therefore, a lower solvent concentration then conventional coatings. In 1994 the General Motors Car Plant in Oshawa converted to higher solids paints and as a result reduced VOCs from the paint application process by approximately 12%. In addition to the environmental benefits there were the added benefits of an improvement in the appearance of the paint finish and the utilization of paint materials in the overall paint production process.

- **Install Air Pollution Control (APC) Equipment** - VOCs emitted from industrial sources can be controlled by "add-on" control methods such as incineration (thermal oxidation or catalytic oxidation) and carbon absorption. These APC devices typically have efficiencies in the 95% range. Typically, the most cost effective means for the reduction of VOCs is through a reduction in the quantity of coating materials used/unit and through a reduction in the quantity of VOCs/unit quantity of coating material. Add-on controls are a less desirable option as they entail substantial capital and operating expenditures and result in no related savings. However, where other reduction methods are not sufficient add-on controls may be required.

- **Use of HVLP (high volume low pressure) Spray Systems** - HVLP systems use high volumes of air rather than high pressure. HVLP gun technology has improved considerably in the last 3 to 4 years and is now capable of delivering a coating quality very nearly comparable with that produced by conventional guns. In HVLP systems, the spray is propelled at a lower velocity producing a soft spray pattern which is reported to result in higher transfer efficiency and lower overspray than conventional spray guns. HVLP

guns were recently tested in a spraybooth at an automotive parts manufacturer in Ontario. Based on the data gathered, the use of HVLP guns should result in a reduction of over 35% in paint used and a pay back period for the conversion of less than one month. Trials uses these guns should be conducted to see if they are appropriate for your operation.

- **Use of Airless spray systems** - Airless spray guns operate at high pressures (in the order of 4000 psi) and, have a high delivery rate and a high efficiency. However, airless guns produce a coarse spray pattern and are therefore only suitable for slow drying paints. Fast drying paints tend to dry before the droplets flow together, giving a rough texture or 'orange peel'.

- **Use of Electrostatic Spray systems** - In electrostatic spray systems the coating particles are attracted to the part to be coated by means of an electric charge. The use of this technology would require the removal of all ignitable materials (mainly solvents) from the paint booth and the creation of a safety room equipped with fire fighting equipment adjacent to the booth.

- **Install Mixing Valve close to the Spray Head** - The installation of a mixing valve close to the gun (say, approximately 3 feet from the head) would result in significant savings in solvent and paint. In a typical two component paint system each time there is an operator break, the line must be purged with solvent to prevent hardening of the material in-line. Trials at one facility using a static mixer and proportioner provided by Mattson showed that approximately 56 litres of paint and solvent could be saved per shift. Based on a capital cost of the equipment estimated at $25,000, the payback was less than 2 months.

- **Reducing the Thickness of the Coating** - at many facilities the actual surface coating thickness is as much as 20% greater than the requirements. A coating thickness greater than that required results in an increased consumption of paint and an increase in VOC emissions. Reducing surface coating thickness can be achieved through operator training and raising operator awareness with respect to the 'cost' of over consumption. The setting of benchmarks on paint consumption/chassis and the continuous monitoring of this parameter is critical to the achievement of this objective. An external PC to provide datalogging and continuous paint consumption measurements can be used to monitor paint use.

- **Electronic Proportioning System** - Using an electronic proportioning system has the advantage that it allows detailed records (on screen display and print out) of the quantity of paint used, the ratio of paint to activator, etc., for each unit painted. Continuous monitoring also allows the determination of benchmarks of the quantity of paint required per part. This information will help reduce the waste paint produced as a result of 'overmixing', whereby in the absence of accurate information on paint required for a given job, too much paint is mixed. The cost of a typical system is $60,000 including installation. Although the actual payback will vary depending on the quantity of paint used, it is expected that the payback will be less than one year.

- **Low VOC Paints** - Paints are currently available that have lower VOC content. In one case investigated recently, one paint manufacturer (Dupont) developed a paint to replace a coating containing 0.42 kg of VOC/litre with one that contained 0.34 kg of VOC/litre. No additional capital or operating expenditures are anticipated to be required to implement the switch from the 0.42 kg of VOC/litre paint to the 0.34 kg of VOC/litre paint, as the cost of the two paints are comparable. The lower VOC paint has the added advantage that it has a lower viscosity and thus is more amenable to use with HVLP guns.

- **Modify Purchase Agreement for Paint** - Chrysler Canada initiated an agreement between the paint vendor to pay a predetermined amount for each vehicle painted rather than pay for the total amount of paint used. In this way the vendor has an economic gain from saving paint instead of having the company use it and the company reduces the cost of painting for each vehicle. In addition, the paint vendor is able to be paid within five days of the vehicle being painted. This has resulted in cost savings, reduction in VOC emissions and reduction in amount paint sludge requiring disposal.

- **Selection of Alternative Coatings** - the US EPA has developed the Coating Alternatives Guide (CAGE), a pollution prevention tool for small- and medium-sized businesses. CAGE is an expert system and information base designed to recommend low-emitting alternative coating technologies to coatings users. In addition, CAGE provides summarized information on recommended alternatives. The expert system asks the user several questions about their current coating process and tries to match up alternatives that fit the user's operating conditions. Version 2.0 of CAGE addresses plastic parts coatings as well as metal parts coatings. The guide is available on the Internet at "http://cage.rti.org".

### 6.6.2 Measures to Reduce Air Emissions from Solvent Usage

- **Solvent Rag Wipe** - To reduce the solvent emissions and to reduce the quantity of solvent used, parts can be wiped down with a solvent soaked rag instead of being sprayed. The workers wipe down the 'hot spots' such as visible stains or dirt and grime. In one trial the solvent usage was reduced by 94% and there was similar removal of dirt and grime from the chassis as solvent wash. The drawback to this method is that it takes longer than the conventional spray wash and may cost more in terms of increased labour than the savings that results in reduced solvent usage. In addition, this method may not be appropriate to intricate parts.

- **Water Wash** - Hot water wash systems are available that first saturate the part with a cleaning agent and water under low pressure (5-10 psi), then the part is blown with hot water (200°F at 300 psi) and finally dried. Although the quality of the wash is better than conventional systems, the capital investment for this type of system is substantial (over $500,000 for a facility producing approximately 50 trucks/day). In addition, extra space is required to accommodate the increased drying time and the operating (labour) costs are expected to be higher.

### 6.6.3 Measures to Reduce Air Emissions from Other Process Operations

- **Reduction/Elimination of Metal Emissions from Soldering Lines -** Instead of soldering two stamped halves of the fuel tanks together using lead solder, plastic fuel tanks may be used thereby eliminating the soldering process. Elimination of lead emitted from the soldering process, health and safety concerns eliminated and eliminated a NPRI substance.

## 6.7 MANAGEMENT STRATEGIES

### 6.7.1 Environmental Management Systems

Environmental management systems are a differentiating feature in the market and they are here to stay. Already, this trend has had a very significant impact on the automotive sector. An example is the adoption of the ISO 14001 standard by car makers such as Ford and Toyota.

As of May 1997, five Ford automotive facilities in North America had been registered to ISO 14001. The Ford Ontario facilities that were registered are the Oakville Assembly Plant, the Windsor Aluminum Plant and the Markham Electronics Plant. It is Ford's goal to have all its plants ISO 14001 registered by the end of 1998. Toyota achieved their first registration to the standard for its Takaoka plant in March 1996, before the standard was officially published by ISO and seems committed to adopt the standard for all of its facilities. It takes little analysis to conclude that it may take time, but suppliers will inevitably be affected.

The advantages and benefits of adopting the discipline of an environmental management system, taking as model the international standard ISO 14001, obviously served to prompt Ford and Toyota to commence registration.

**Benefits**

**1- Reduced Costs**

A critical examination of the environmental aspects of products, activities and services can lead to better products and production processes which reduce waste, energy input, improve reuse and recycling and ultimately reduce costs.

Often, lower transportation and storage costs are associated with less material and energy input.

Critical analyses and associated actions create an easier compliance by the company with environmental standards and existing regulations. They also lower risks of redesigning due to changing regulations and customer perception, which reduces the potential environmental impact (the focus of the environmental management system) lowering the probability of pollution which may attract charges and penalties. The result is lower costs.

Reduced material and energy use due to better utilization, substitution, waste prevention and energy saving programs leads to less working capital, and may lead to less end-of-pipe capital investments as well as less warehousing investments.

Other benefits which may be less tangible, such as corporate and public image, less regulatory interference, etc. do have a cost component. Evidently, the cost factor permeates the benefits which an environmental management system provides.

**2 - Reduction Of Liability**

Liability refers to both company and personal liability. A distinctive feature of most environmental protection legislation is the absence of a "fault" requirement in the commission of an offense. Most environmental offenses are "strict liability" offenses which means that to lay charges, the Crown only needs to establish that the prohibited act occurred. The defense must establish that either the prohibited act did not occur or that the defendant took every reasonable precaution to avoid the prohibited act (due diligence)

An effective environmental management system following the discipline of ISO 14001 provides objective evidence that the company allocated resources and efforts to reduce the probability of occurrence of undesirable environmental incidents. Therefore, though it is not a guarantee against prosecution or conviction, it becomes a key element of due diligence defence.

Nobody expects environmental accidents to happen, but if they do, a well established environmental management system is probably the best insurance policy to have.

**3 - Supports Conformance to QS 9000**

A careful reading of QS 9000 reveals some requirements which may necessitate a good environmental management system in place to be fully met. Examples

are clauses 4.6.3 which require compliance with "governmental and safety constraints on restricted, toxic and hazardous substances" and 4.9 which lists as an added requirement to the ISO based requirements the need for a process to ensure compliance with environmental and safety and health legislation. These processes are obviously subject to registration and surveillance audits.

Although registrars may tend to overlook the full implications of these and other clauses, it is an advantage to acknowledge and address the potential requirements latent in this document. The discipline of ISO 14001 can provide a great benefit in this regard.

**4 - Assuring Good Relationships with Stakeholders**

While some issues such as quality are narrow in interest, satisfying the needs and expectations of customers, environmental issues are broad in appeal and interest. As a result, many interested parties perceive themselves affected by the approach the company uses to face those issues. These interested parties may include:

- Customers, who may not want to be associated with "polluters";
- Suppliers;
- Community surrounding the facility and public at large who may use the media and the Environmental Bill of Rights to "punish" a company for poor environmental behaviour;
- Investors who may grow more demanding regarding the environmental behaviour of their funds' beneficiaries;
- Financial and insurance institutions;
- Government agencies, from which permits are sometimes required; and
- Employees.

A registered company can offer independent third party proof of conformance to environmental management standards which may result in substantial benefits when needed.

**5 - Enhances a Company's Ability to Export**

Once the ISO 14001 standard was published in September 1996, the door opened for considering it as a selection tool to distinguish between otherwise equal tenders. Many would say, as a mechanism for selecting "favoured" contractors in competitive tendering situations. Perhaps a good way to illustrate this situation is to know how the Asian countries that value and depend on

international trade, have reacted to the standard. The number of registrations to ISO 14001 in some Asia Pacific countries at the end of 1996 are as follows:

| | |
|---|---|
| Japan | 143 |
| South Korea | 65 |
| Taiwan | 34 |
| Australia/New Zealand | 20 |
| Thailand | 7 |
| Singapore | 6 |
| India | 6 |
| Malaysia | 5 |

The UK, as a comparison, led the world in registrations at the end of 1996 with 261 across 180 companies.

Although there is no indication yet that Asian countries will use ISO 14001 certification as a barrier to trade with western companies, the advantages to have the registration for exporting, and suppliers to exporting, companies is clear.

Many advantages and benefits come to a company striving to achieve excellence in their environmental management by adopting a system and seeking to comply with the ISO 14001 requirements. These depend on the individual circumstances for each company. It is very clear, that the stakeholders' trend towards demanding evidence of improving environmental performance and behaviour will continue to increase and automotive suppliers are going to face those demands earlier than other industry sectors. An effective environmental management system following the ISO 14001 prescriptions can be critical in obtaining and maintaining a competitive edge.

### 6.7.2 Typical EMS / ISO14001 Workplan

The ISO 14001 specifications are defined by 6 key elements, namely:

- General Requirements (Element 4.1)
- Environmental Policy (Element 4.2)
- Planning (Element 4.3)
- Implementation and Operations (Element 4.4)
- Checking and Corrective Action (Element 4.5)
- Management Review (Element 4.6)

Under each of these individual Elements are additional activities known as Sub-Elements. The work required to achieve registration ensures that each of these

Sub-Elements and Elements are addressed in an appropriate and effective manner. The most efficient way to accomplish this task is to track each activity completed against the Elements and Sub-Elements.

The "starting point" for developing an EMS is normally determined using the existing information from a "Gap" analysis performed by plant personnel. The performance of the plant is assessed relative to the specifications set out in an EMS program for ISO 14001. As an example, if the plant has a Corporate Environmental Policy, the "score" under this Element (4.2) is likely to be 100% out of a possible 100% and no additional activity is required as no "gap" exists. Sub-Element 4.4.7, Emergency Preparedness and Response might score 65% out of a possible 100%. The additional activities required to "close the gap" under 4.4.7 is identified and plant employee(s) are selected to "champion" efforts to complete the remaining 35% within a suitable time.

Tracking each of the activities can best be done in the form of a chart which identifies the percentage completion of each task, the time frame scheduled to complete each task, and where appropriate, the individual "champion" who is responsible for successfully co-ordinating the ISO 14001 requirements for each of the Elements and Sub-Elements.

In establishing a procedure of this type, the plant is able to control the process and be able to adjust the schedule or the focus on each specific Element or Sub-Element to suit its own internal workload, scheduling, resources and objectives. Additionally, the tracking form is normally mounted and used as a visual tool to advise plant employees on the ongoing status of EMS development.

Once the plant has achieved completion of all activities under each Element and Sub-Element, a period of operating time is required to assess the effectiveness of the EMS, and to "fine tune" it for the final audit. After a successful period of operation, during which objective evidence of compliance can be assessed, a Registrar is then invited to audit the EMS and the plant can proceed towards registration of its' EMS against the ISO 14001 specifications.

#### 6.7.2.1 Identify Environmental Aspects

Strategic review of all environmental aspects of the plants activities, products and services should be conducted. This requires an understanding of the process operations, material used and their potential for environmental impact.

#### 6.7.2.2 Establish Measurable Targets

Sub-Element 4.3.3 Objectives and Targets provides the requirements for establishing objectives and targets. At the centre of this task is the need to consider significant environmental aspects and other requirements. Under the previous step, many significant environmental aspects are normally identified but the key to a successful and strategic EMS is to select the top 4 or 5 company wide significant environmental aspects (SEA's) for several reasons:

1. It is easier to remember 4 or 5 targets than a larger number.

2. Focus efforts.

3. Tackle the important aspects.

4. Easier to succeed.

Having narrowed the field to a manageable number of objectives, the "march" to full EMS can begin in earnest. Once an EMS has been implemented, the requirement for continual (or continuous) improvement normally will result in revisiting the list of significant aspects, changing the priorities and focusing on new measurable targets.

### 6.7.2.3 Establish Project Team

Typically Sub-Element 4.3.4 would be dealt with next. However, before an acceptable Environmental Management Program(s) (4.3.4) can be developed, sufficient effort must be placed on identifying the Structure and Responsibility (Sub-Element 4.4.1) and authorities of the various individuals and resources available.

Definition of a Project Team and clarification or confirmation of the role(s) of each of the Project Team members is likely all that is required under this element and it can best be addressed at the initial environmental aspects workshop.

On completion of the definition of the roles and responsibilities of the Project Team, the next step will be Sub-Element 4.3.4 - Environmental Management Program(s).

### 6.7.2.4 Environmental Management Program(s)

Under Sub-Element 4.3.4, a strategy has to be developed and communicated on how the plant plans to implement its' EMS. Any strategy has to identify its resources and utilize the existing in-place frame work (i.e. structure and responsibility) to address and meet its measurable targets. Normally, the EMP is organized around the 4 or 5 measurable targets and the resources available such as "champions", employees, cost, time, training etc. is defined.

### 6.7.2.5 Training

At this point of the program, the significant environmental aspects have been identified and anyone remotely connected to the significant environmental aspects should be apprised of their importance. Training needs (4.4.2) are then identified and employees made aware of the consequences of failure to follow procedures. Staff at all levels in the organization must be provided with the appropriate resources to understand, develop and participate in the EMS. Training needs might include:

- emergency preparedness and response;

- record keeping;

- all elements of ISO 14001, as required; and
- orientation of new employees and possibly reassigned employees.

#### 6.7.2.6 Communications

There are two strategies for effective communication. One involves internal communication and the other external communication (i.e. to the public).

ISO 14001 Sub-Element (4.4.3) does not demand external communication but only asks that you *"consider processes for external communication on its significant environmental aspects and record its decision".*

The following outlines potential opportunities:

**Internal Communications**

The paramount objective of internal communication is to build awareness, understanding and "buy-in" among staff regarding ISO 14000 and continued improvement of environmental practices.

Individuals within the organization will play key roles in facilitating internal communications. The Project Team or Management Representative should be the leader of the process and, as such, "champion" communications within the plant. Responsibilities include:

- coordinate communications;
- accept and disseminate information;
- support others in the communications; and
- ensure the process maintains a position in the forefront of plant initiatives.

The Project Team will provide essential "day-to-day" facilitation of internal communications by encouraging staff to actively participate in the ISO 14000 process by providing information and implementing tasks. Through these efforts, these individuals should:

- foster corporate and individual commitment to the ISO 14000 process and objectives; and
- develop a "culture" of environmental excellence.

Project "champions" should provide the "day-to-day" communications support for the Team by promoting the process and individual responsibility among all employees.

The tools to facilitate internal communications will likely be varied, and should be employed at key points in the process to ensure effective, timely communication. Some key communications activities internally may include:

- project "kick-off" presentations which outline the process, goals and employee responsibility;
- newsletters and bulletins to provide updates on the process, identify opportunities for participation and solicit employees' ideas;
- milestone announcements which illustrate key successes, identify future initiatives, and promote ongoing commitment and "buy-in";
- recognition programs to "thank" key staff for contributions to the process; and
- ongoing communications activities, such as newsletters and information sessions, to promote ISO 14000 beyond implementation.

**External Communications**

The primary objective of external communications is to enhance the plants profile and reputation regarding it's commitment to environmental excellence.

Communication with the broader community could be facilitated through a variety of methods, such as:

- "kick-off" announcements in local media;
- regular newsletters and press releases;
- information sessions and public displays;
- milestone announcements at key points; and
- a "celebration" upon receipt of registration.

Successful external communication will enhance reputation and recognition

**6.7.2.7 Optional Activities**

**Environmental Compliance Audit**

One of the key elements of the ISO 14001 Specification involves a review of environmental aspects, while a second key element requires compliance with legislative and other requirements. Normally an outside consultant is awarded a contract to conduct an Environmental Audit and identify areas of non-compliance, if any. The Environmental Audit report to be produced and submitted to the plant should be used to assist in establishing significant environmental aspects, developing the EMS, and setting measurable objectives and targets. Ideally an Environmental Audit should be conducted early on in the process.

The increasing application of Environmental Audits to operating facilities reflects a heightened commitment to environmental stewardship and the desire to demonstrate due diligence and to minimize liabilities associated with environmental damage. An environmental audit will normally include but not be limited to:

- Air Emissions
- Water Discharges
- Hazardous Materials Management
- Waste Disposal
- Low Level Radioactive Material
- Underground and Aboveground Storage Tanks
- Asbestos
- Polychlorinated Biphenyls (PCBs)
- Chlorofluorocarbons (CFCs)

Each of these areas should be reviewed in detail and current operations should be assessed against the relative provincial and federal environmental legislation.

**Internal Auditor Training Sessions**

Through the QS-9000 initiatives which most companies have either completed or are in the process of completing has resulted in a well trained group of internal quality auditors taking care of the QS-9000 Quality System. Most plants, therefore, expand the QS-9000 internal auditor training, through a one day workshop, to include EMS. The compliance audit, the training requirements of the standard and the internal communications can produce the necessary awareness regarding environmental legislation, therefore, the workshop would be aimed at transferring skills and knowledge of the auditing standards, ISO 14010, 14011 and 14012.

### 6.7.3 Government/Association Initiatives

In addition to the Acts, Regulations and Codes which control the handling and use of various chemicals there are a number of initiatives which have been adopted by the automotive industry which restrict the purchasing, use and disposal of specific chemicals which may be used in a plant. Some of these programs are summarized below.

- ***CCME $NO_x$/VOC Management Plan***

Ground-level ozone is produced when two primary pollutants, nitrogen oxides ($NO_x$) and volatile organic compounds (VOCs), react in the presence of sunlight to produce photochemical smog. The principle component of smog is ozone. It is a potentially harmful gas which, in elevated concentrations, can have deleterious effects on human health and vegetation. In recognition of the seriousness of Canada's ground-level ozone problem, the Canadian Council of Ministers of the Environment (CCME) developed the $NO_x$/VOC Management Plan in 1990. The national prevention program has led to the development of 31 federally led initiatives aimed at providing source guidelines and performance standards for various, sector specific, sources of $NO_x$/VOC emissions across Canada. The source control initiatives which can affect the automotive parts industry are:

- Initiative N307/N308 - Concerns the development of new source emission guidelines for commercial / industrial coating application and printing facilities. A number of industrial sector specific working groups have been and are working towards draft guidelines. The guideline which is geared towards Automotive Parts Manufactures is currently under development and is expected to be in the draft phase by 1997.

The source performance standards and guidelines for the reduction of volatile organic compound emissions from Canadian Automotive Manufacturers is expected in to define a target reduction of approximately 60%. The limits will be developed in association with industry and will be based upon limits which are considered realistic and achievable under the project remit of BACTEA (Best Available Control Technology Economically Achievable).

- ***Ontario Smog Management Plan***

This initiative calls on individuals, businesses, organizations and government to develop and implement actions to reduce emissions of contaminants that contribute to the photochemical smog problem in Ontario. The goals are to reduce Ontario emissions of nitrogen oxides, volatile organic compounds, and inhalable and respirable particulates. The Ministry will release the Ontario Smog Plan in 1997. The APMA has signed a letter of Cooperation with the province outlining the Association's and member companies' intention to develop sector targets and action plans.

- ***Pollution Prevention Pledge Program (P4)***

The Pollution Prevention Pledge Program (P4) of the Ontario Ministry of the Environment (MOE) acknowledges the environmental achievements of industrial, commercial, institutional, community and governmental enterprises. The program is designed to encourage the voluntary adoption of pollution prevention and pollution prevention planning throughout the province. Auto parts companies which have achieved recognition through this program are: Hastech Manufacturing (a Linamar Company), Monroe Auto Equipment Co. of Canada, Roctel Manufacturing (a Linamar Company), Kuntz Electroplating and Velcro Canada.

- ***The Automotive Parts Manufacturing Pollution Prevention Project***

The Automotive Parts Manufacturing Pollution Prevention Project is a co-operative effort by the Automotive Parts Manufacturers' Association (APMA) and its participating member companies, the Ontario Ministry of the Environment (MOE), and Environment Canada. Under the Memorandum of Understanding (MOU), auto parts manufacturers are voluntarily developing and implementing environmental management systems and pollution prevention plans as part of the federal Great Lakes Pollution Prevention Initiative and Ontario's Pollution Prevention Strategy. The goal is to achieve a verifiable reduction of persistent toxic substances and other contaminants of concern that are used generated or released into the environment.

In March 1996, the second MOU progress report, which included case studies and reductions, was released. Five of the participating companies have undertaken 22 pollution prevention case studies and achieved annual reductions of 660 tonnes of toxic substances and other wastes as well as significant reductions in energy and water consumption (see Section 9.1 of this report for examples).

- ***The Canadian Vehicle Manufacturing Pollution Prevention Project***

The Canadian Vehicle Manufacturing Pollution Prevention Project (formerly the Automotive Manufacturing Pollution Prevention Project) was initiated in May 1992. The CVMA project is a cooperative effort between the participating members of the Canadian Motor Vehicle Manufacturers' Association (CVMA), the Ontario Ministry of the Environment (MOE), and Environment Canada. This program has a similar focus to the Automotive Parts Manufacturing Pollution Prevention Project.

- ***Accelerated Reduction or Elimination of Toxics (ARET) Program***

The Accelerated Reduction or Elimination of Toxics (ARET) Program is a voluntary federal government program which is aimed at decreasing the adverse effects of toxic substances on human health and the environment by accelerating the reduction/elimination of selected toxic substance emissions. ARET's goal is achieved by challenging industrial and government organizations to reduce or eliminate emissions of 117 toxic substances.

- ***National Pollutant Release Inventory (NPRI)***

The National Pollutant Release Inventory (NPRI) is a federal government initiative which is designed to establish a comprehensive national database of releases to air, water and land and transfers in waste of specified substances. It is a requirement under the Canadian Environmental Protection Act of owners or operators of facilities that manufacture, process or otherwise use one or more of the 176 specified substances under prescribed conditions to report to the NPRI annually.

- ***Industrial Energy Innovators Initiative (IEII)***

The Industrial Energy Innovators Initiative (IEII) is based on voluntary action by industry to increase energy efficiency. This program was developed by the Industrial, Commercial and Institutional Programs Division of the Energy Efficiency Branch of Natural Resources Canada. To become an Industrial Energy Innovator, a company's CEO signs a commitment letter agreeing to:

- develop and implement and energy efficiency improvement target or goal-setting process and action plan;
- nominate an energy efficiency champion; and
- track and report the results of their energy efficiency on an annual basis.

An enrollment letter for this program is provided in Appendix A.

- ***Voluntary Challenge and Registry Program (VCR)***

The Voluntary Challenge and Registry Program (VCR) program was started in 1995 in response to the problem of climate change caused by the greenhouse effect. VCR is a voluntary program to encourage companies, institutions and governments to reduce their emissions of greenhouse gases. Companies which participate in the VCR reduce their emissions of greenhouse gases, by implementing energy conservation and waste reduction measures.

The most important greenhouse gas is carbon dioxide ($CO_2$) which is produced by the combustion of fossil fuels containing carbon. The next most important greenhouse gas is methane ($CH_4$), the main component in natural gas. Methane is also produced by the decomposition of plant and animal material in the absence of air. Many scientists believe that human activities are emitting greenhouse gases faster than the earth can absorb and eliminate them. The consequence is that the earth's climate is becoming warmer, with serious consequences.

Why should an automotive parts manufacturer participate in the VCR? The Ministry of the Environment offers to VCR participants many opportunities to save energy, reduce waste, and reduce operating costs. Participants in the VCR benefit from public recognition of their environmental efforts. The VCR is a voluntary program where governments and private industry work together.

How can an automotive parts manufacturer participate join the VCR? The first stage is a Letter of Intent from the Chief Executive Officer of the company to the Director of the VCR. The company then submits an Action Plan, showing how the company intends to reduce emissions of greenhouse gases. The company submits annual Progress Reports to the VCR office, showing the company's progress in reducing emissions of greenhouse gases.

Many Ontario automotive and automotive parts manufactures are now participants in the VCR. These companies include Cami Automotive Inc., Chrysler Canada Ltd., Ford Motor Company of Canada Ltd., General Motors of Canada Ltd., Toyota Motor Manufacturing Canada Inc., Woodbridge Group, Accuride, Altex Automotive Castings, Canadian General-Tower, Collins & Aikman Canada, Eaton Corporation - Suspension Division, Eaton Yale, Husky Injection Molding Systems, Kelsey Hayes Canada, LaGran Canada, Magna, and Rockwell International.

The Letter of Intent, Action Plan and Progress Reports for each participant are displayed on the VCR World Wide Web Site, http://www.vcr-mvr.ca. Also included on the web site is information on how to prepare the Letter of Intent and following reports. A printed copy of "About the Program" and "How to Get Involved!" from the World Wide Web Site of VCR is included as Appendix B.

The Ministry of the Environment, Industry Conservation Branch, will assist Ontario companies with planning and implementing their VCR efforts, and with preparing VCR progress reports (416-327-1443).

# 7.0 PRIORITIES AND IMPLEMENTATION

## 7.1 SUMMARY CHECK LIST OF RESOURCE CONSERVATION AND ENVIRONMENTAL IMPROVEMENT MEASURES

Table 7.1 provides a summary of the resource conservation and environmental improvement measures described in detail in Section 6.

## 7.2 WORKSHEETS

Tables 7.2 to 7.5 provide worksheets to be used to assist in identifying key opportunities. Worksheets are provided to identify opportunities in the following areas:

- Electrical Systems
- Boiler Systems
- Compressed Air Systems
- Water Usage
- Waste Generation

These worksheets are intended to assist in highlighting utility costs and identifying potential saving opportunities.

**TABLE 7.1**
**SUMMARY CHECK LIST OF RESOURCE CONSERVATION AND ENVIRONMENTAL IMPROVEMENT MEASURES**

| CATEGORY | POTENTIAL OPPORTUNITY | BENEFIT | APPLICATION | REFERENCE |
|---|---|---|---|---|
| Process Improvements | Closed-Loop Drying Systems | Increased energy efficiency | Water washed components drying, water based paints drying, sludge drying | 6.1.1 |
| | Hydroforming | Decreased use of Lubricants | Replacement of some stamping operations | 6.1.2 |
| Energy<br>Boiler Operation | Repair Steam Leaks | Increased energy efficiency | All steam systems with poor condensate return | 6.2.1 |
| | Improve Boiler Efficiency | Increased energy efficiency | All boilers with low operating efficiencies | 6.2.1 |
| | Insulate Condensate Return Piping and Fittings | Increased energy efficiency | Any uninsulated piping | 6.2.1 |
| | Insulate Chilled Water Return Lines | Increased energy efficiency | Any uninsulated piping | 6.2.1 |
| | Investigate Cogeneration | Increased energy efficiency | Facilities with large electrical and steam loads | 6.2.1 |
| | Install a More Efficient Boiler | Increased energy efficiency | Facilities with older inefficient boilers | 6.2.1 |
| | Replace Fuel Oil or Bunker C with Natural Gas | Decreased Emissions of Sulphur Dioxide, decreased spill potential | Any facility still using liquid fuel that has access to natural gas | 6.2.1 |
| Electrical Systems | Conduct a Lighting Survey | Increased energy efficiency | Facilities not using high efficiency lighting systems | 6.2.2 |
| | Investigate the Use of Variable Speed Motors and Drives | Increased energy efficiency | Facilities that have high electrical costs related to motors | 6.2.2 |

**TABLE 7.1**
**SUMMARY CHECK LIST OF RESOURCE CONSERVATION AND ENVIRONMENTAL IMPROVEMENT MEASURES**

| CATEGORY | POTENTIAL OPPORTUNITY | BENEFIT | APPLICATION | REFERENCE |
|---|---|---|---|---|
| Electrical Systems | Reduce Peak Demand | Increased energy efficiency | Facilities that pay a high proportion of their electrical bill for demand changes | 6.2.2 |
| | Improve Power Factor | Increased energy efficiency | Facilities that pay a penalty for a low power factor on their utility bill | 6.2.2 |
| Compressed Air | Reduce Air Leaks | Increased energy efficiency | Facilities that use compressed air | 6.2.3 |
| | Install Automatic Shutoff | Increased energy efficiency | Facilities that use compressed air | 6.2.3 |
| | Install Flowmeters | Improved Monitoring of Usage | Facilities that use compressed air | 6.2.3 |
| | Compressed Air Operating Mode | Increased energy efficiency | Facilities that use compressed air | 6.2.3 |
| | Install Compressed Air Nozzles | Increased energy efficiency | Facilities that use compressed air | 6.2.3 |
| | Install Control System | Increased energy efficiency | Facilities that use compressed air | 6.2.3 |
| Cooling Towers | Increase Temperature Gradient | Increased energy efficiency | Facilities with Cooling Towers | 6.2.4 |
| | Reduce Scaling | Increased energy efficiency | Facilities with Cooling Towers | 6.2.4 |
| | Reduce Blowdown Frequency | Reduced Use of Makeup Water and Chemicals | Facilities with Cooling Towers | 6.2.4 |
| Chilled Water | Containment of CFCs in Existing Chillers | Prevention of Accidental Loss of CFCs | Chillers that use CFCs that still have a useful life | 6.2.5 |
| | Conversion of Existing Chillers to non-CFC Refrigerants | Prevention of Accidental Loss of CFCs and Short Supply of Available CFCs | Positive Pressure Chillers | 6.2.5 |
| | Replacement of Existing Chillers with non-CFC Refrigerants | Improved energy efficiency and prevention of accidental loss of CFCs | All new and replacement chillers | 6.2.5 |

**TABLE 7.1**
**SUMMARY CHECK LIST OF RESOURCE CONSERVATION AND ENVIRONMENTAL IMPROVEMENT MEASURES**

| CATEGORY | POTENTIAL OPPORTUNITY | BENEFIT | APPLICATION | REFERENCE |
|---|---|---|---|---|
| Other | Set Back Temperatures | Reduced Energy Usage | Facilities that do not operate 24 hours a day seven days a week | 6.2.6 |
| | Spray Booth HVAC Shut Down | Reduced Energy Usage | Facilities that do not operate 24 hours a day seven days a week | 6.2.6 |
| | Energy Use Monitoring | Improved Monitoring of Usage | All Facilities with significant utility costs | 6.2.7 |
| Water | Install Flowmeters | Improved Monitoring of Usage | Facilities with high water costs | 6.3 |
| | Conduct Regular Maintenance | Reduction in Water Usage | All Facilities | 6.3 |
| Sanitary Water | Install Water Efficient Shower Heads | Reduction in Water Usage | Facilities with shower facilities | 6.3.1 |
| | Install Faucet Aerators | Reduction in Water Usage | All Facilities | 6.3.1 |
| | Install Hose Nozzles | Reduction in Water Usage | All Facilities | 6.3.1 |
| | Adjust or Replace Toilets to use less Water per Flush | Reduction in Water Usage | All Facilities | 6.3.1 |
| Process Water | Cooling Tower Water Use Reduction | Reduction in Water Usage | Facilities with cooling towers | 6.3.2 |
| | Parts Washer Water Use Reduction | Reduction in Water Usage | Facilities with parts washers | 6.3.2 |
| Chemicals | | | | |
| Management of PCBs | Remove PCB Electrical Equipment | Elimination of Hazardous Materials | Facilities that have PCBs on site | 6.4.1 |
| Selection of Non-Production Materials | Eliminate use of Lead in Greases | Elimination of Hazardous Materials | Facilities that use greases containing lead | 6.4.2 |

**TABLE 7.1**
**SUMMARY CHECK LIST OF RESOURCE CONSERVATION AND ENVIRONMENTAL IMPROVEMENT MEASURES**

| CATEGORY | POTENTIAL OPPORTUNITY | BENEFIT | APPLICATION | REFERENCE |
|---|---|---|---|---|
| Selection of Non-Production Materials | Eliminate Phenol In Cutting Oils | Elimination of Hazardous Materials | Facilities that use cutting oils | 6.4.2 |
| | Eliminate Phenol In Casting | Elimination of Hazardous Materials | Casting | 6.4.2 |
| | Eliminate Zinc In Hydraulic Oil | Elimination of Hazardous Materials | Facilities that use hydraulic oil that contains zinc | 6.4.2 |
| | Eliminate Hydrochloric Acid and Caustic use for Deionized water | Elimination of Hazardous Materials | Facilities that can replace deionized water with RO water | 6.4.2 |
| | Eliminate use of Methylene Chloride | Elimination of Hazardous Materials and Reduction of VOC Emissions | Any facility still using methylene chloride | 6.4.2 |
| | Reduce use of Solvent Based Adhesives | Elimination of Hazardous Materials and Reduction of VOC Emissions | Any facility using solvent based adhesives | 6.4.2 |
| | Replacement of Oil Based Drawing Compounds | Elimination of Hazardous Materials | Any facility using drawing compounds | 6.4.2 |
| Elimination of Ozone Depleting Substances | Eliminate use of 1,1,1-Trichloroethane as a Mold Release Agent | Elimination of Hazardous Materials and Reduction of VOC Emissions | Molding | 6.4.3 |
| | Eliminate use of 1,1,1-Trichloroethane as a Cleaner | Elimination of Hazardous Materials and Reduction of VOC Emissions | Cleaning Operations | 6.4.3 |
| | Eliminate use of 1,1,1-Trichloroethane in Halogenated Solvents | Elimination of Hazardous Materials and Reduction of VOC Emissions | Halogenated Solvents | 6.4.3 |
| | Replacement of Cleaning Solvents | Elimination of Hazardous Materials and Reduction of VOC Emissions | Cleaning Operations | 6.4.3 |

**TABLE 7.1**
**SUMMARY CHECK LIST OF RESOURCE CONSERVATION AND ENVIRONMENTAL IMPROVEMENT MEASURES**

| CATEGORY | POTENTIAL OPPORTUNITY | BENEFIT | APPLICATION | REFERENCE |
|---|---|---|---|---|
| Wastewater<br>Investigate use of Treatment Technologies Available | Pre-Treatment | Improved Wastewater Effluent Quality | Facilities that require treatment of their wastewater effluent | 6.5.1 |
| Investigate use of Treatment Technologies Available | Chemical Precipitation | Improved Wastewater Effluent Quality | Facilities that require treatment of their wastewater effluent | 6.5.1 |
| | Biological Treatment | Improved Wastewater Effluent Quality | Facilities that require treatment of their wastewater effluent | 6.5.1 |
| | Solids Polishing | Improved Wastewater Effluent Quality | Facilities that require treatment of their wastewater effluent | 6.5.1 |
| | Complex or Specialized Treatment | Improved Wastewater Effluent Quality | Facilities that require treatment of their wastewater effluent | 6.5.1 |
| Solid Waste | Recycle Corrugated Cardboard | Reduced Waste Generation, Reduced Disposal Costs | All Facilities | 6.5.2.2 |
| | Recycle Beverage Containers | Reduced Waste Generation, Reduced Disposal Costs | All Facilities | 6.5.2.2 |
| | Reuse Wood Pallets | Reduced Waste Generation, Reduced Disposal Costs | All Facilities | 6.5.2.2 |
| | Reduce Office Paper Use, Double Side Copies, Reuse Draft Paper, Buy Recycled Paper | Reduced Waste Generation, Reduced Disposal Costs | All Facilities | 6.5.2.2 |
| | Use Returnable Containers | Reduced Waste Generation, Reduced Disposal Costs | All Facilities | 6.5.2.2 |

**TABLE 7.1**
**SUMMARY CHECK LIST OF RESOURCE CONSERVATION AND ENVIRONMENTAL IMPROVEMENT MEASURES**

| CATEGORY | POTENTIAL OPPORTUNITY | BENEFIT | APPLICATION | REFERENCE |
|---|---|---|---|---|
| Solid Waste | Recycle Stretch Wrap | Reduced Waste Generation, Reduced Disposal Costs | All Facilities that generate significant quantities of this waste type | 6.6 |
| Air Emissions | | | | |
| Painting Operations | Increase Transfer Efficiency | Reduced VOC Emissions | Painting Operations | 6.6.1 |
| Painting Operations | Convert to Water-borne Coatings | Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Convert to High Concentration Solids Coatings | Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Install Air Pollution Control Equipment | Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Use of HVLP Spray Systems | Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Use of Airless Spray Systems | Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Use of Electrostatic Spray Systems | Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Install Mixing Valve close to Spray Head | Decreased Raw Material Usage and Reduced Waste Generation | Painting Operations | 6.6.1 |
| | Reduce Thickness of Coating | Decreased Raw Material Usage and Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Electronic Proportioning System | Decreased Raw Material Usage and Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Low VOC Paints | Reduced VOC Emissions | Painting Operations | 6.6.1 |
| | Modify Purchase Agreement for Paint | Decreased Raw Material Usage | Painting Operations | 6.6.1 |

**TABLE 7.1**
**SUMMARY CHECK LIST OF RESOURCE CONSERVATION AND ENVIRONMENTAL IMPROVEMENT MEASURES**

| CATEGORY | POTENTIAL OPPORTUNITY | BENEFIT | APPLICATION | REFERENCE |
|---|---|---|---|---|
| Solvent Usage | Solvent Rag Wipe | Reduced Solvent Usage and Reduced VOC Emissions | Cleaning Operations | 6.6.2 |
| | Water Wash | Reduced VOC Emissions | Cleaning Operations | 6.6.2 |
| Other | Reduction/Elimination of Metal Emissions for Soldering Lines | Reduced Metal Emissions | Soldering Operations | 6.6.2 |
| Management Strategies | Implement an Environmental Management System | Improved Monitoring of Environmental Issues | All Facilities | 6.7.1 |
| | Participate in the Automotive Parts Manufacturing Pollution Prevention Projects | Improved Flow of Knowledge Related to Pollution Prevention Opportunities | All Facilities | 6.7.2 |
| | Participate in the Accelerated Reduction of Elimination of Toxics Program | Demonstrate Corporate Commitment to Improving the Environment | All Facilities | 6.7.2 |
| | Participate in the Industrial Energy Innovators Initiative | Demonstrate Corporate Commitment to Improving the Environment | All Facilities | 6.7.2 |
| | Participate in the Voluntary Challenge and Registry Program | Demonstrate Corporate Commitment to Improving the Environment | All Facilities | 6.7.2 |
| | Participate in the Ontario Smog Management Plan | Demonstrate Corporate Commitment to Improving the Environment | All Facilities | 6.7.2 |

## TABLE 7.2
## BOILER IMPROVEMENT OPPORTUNITIES WORKSHEET

| Plant Position | | | Typical Values |
|---|---|---|---|
| **Annual Fuel Cost (Boiler only)** | | | |
| Natural Gas: | _____ | | |
| No. 2 Fuel Oil: | _____ | | |
| Bunker C: | _____ | | |
| Other: | _____ | | |
| Total Fuel Cost: | _____ | | |
| Boiler System Efficiency: | _____ | | 65 - 80% |
| **Annual Make-up Water Cost (Boiler only)** | | | |
| Quantity of Make-up water (annual): | _____ | | |
| Cost of Water: | _____ | | $0.80 - 1.00/m$^3$ |
| Cost of Treating Water: | _____ | | $0.25 - 0.70/m$^3$ |
| Cost of Heating Make-up Water to Condensate Return Temperature: | _____ | | |
| Total Water Cost: | _____ | | |
| Percent Condensate Return: | _____ | | 65 - 85% |
| **Unit Costs** | | | |
| Annual Steam Production: | _____ | lb | |
| Fuel Cost: | _____ | $/1000 lb | |
| Water Cost: | _____ | $/1000 lb | |
| Total Steam Cost: | _____ | $/1000 lb | $10-15 |

**OPPORTUNITIES**

| | |
|---|---|
| Repair Steam Leaks:<br>Reference: 6.2.1 | A single steam trap leaking 100 psig steam through a 1/16" orifice will lose approximately 13 pounds of steam per hour. Using a price of $10/1000 lbs, the cost of this single leak is $1140/year. |
| Improve Boiler Efficiency<br>Reference: 6.2.1 | In terms of costs, a facility that has an average steam generation rate of 10,000 lb/hr and an efficiency of 65% would pay $41,000 more in annual natural gas costs than a similar facility with a boiler efficiency of 70% ($0.15/m$^3$ natural gas). |
| Insulate Condensate Lines and Chilled Water Lines<br>Reference 6.2.1 | For a temperature differential of 50°C (122°F), the estimated annual cost of the heat loss was $67 per metre for an uninsulated 15.2 cm (6 inch) line. Under the same conditions, the estimated annual cost of the heat loss was $42 per metre for an uninsulated 10 cm (4 inch) condensate line. |

## TABLE 7.3
## ELECTRICAL SYSTEM IMPROVEMENT OPPORTUNITIES WORKSHEET

| Plant Position | | | Typical Values |
|---|---|---|---|
| Electrical Use (kWh) (A): | _____ | Annual | |
| Peak Demand (kW) (B): | _____ | Average | |
| Power Factor (%): | _____ | Annual Average | 90%+ |
| Load Factor (%) | | | |
| (A / (B x 24 x 365)): | _____ | Annual Average | 65%-75% |
| Annual Consumption Cost: | _____ | | |
| Annual Demand Charge | _____ | | |
| Annual Poor Power Factor Cost: | _____ | | |
| Total Electrical Cost: | _____ | | |

**OPPORTUNITIES**

| | |
|---|---|
| Lighting Survey<br>Reference: 6.2.2 | Retrofitting existing lighting with low wattage, energy efficient fluorescent, halide or high intensity discharge lamps is generally cost effective. Benefits include: reduction in consumption and demand charges and a reduced load on air conditioning systems. |
| Variable Speed Drives<br>Reference: 6.2.2 | For applications where the load fluctuates, the use of a variable speed drive on the pump will reduce energy consumption. The use of variable speed motors and drives requires thorough investigation to ensure that the equipment is adequately sized and appropriate for the application. |
| Peak Demand<br>Reference: 6.2.2 | In order to reduce the peak load there are three options, load shedding, load shifting and generally reducing power requirements. In load shedding non-essential equipment is shut off during the peak period. Load shifting involves rescheduling activities so that they take place during off peak times. |
| Power Factor<br>Reference: 6.2.2 | A low power factor is usually caused by inductive loads such as transformers, lighting ballasts and AC induction motors. A simple review of your current electrical bill should identify whether you are paying a penalty. As a demonstration, consider a facility that has an peak monthly demand of 5000 kW. If the power factor is above 90%, the monthly cost for demand using a cost of $15/kW is $75,000. With a power factor of 85% the monthly cost increases by 6% to $79,412. The additional annual cost due to the poor power factor would be $52,940. |

## TABLE 7.4
## COMPRESSED AIR SYSTEM IMPROVEMENT OPPORTUNITIES WORKSHEET

| Plant Position | | | Typical Values |
|---|---|---|---|
| **Equipment** | | | |
| Total motor HP installed (A): | _____ | HP | |
| Total installed capacity(B): | _____ | CFM | |
| **Utilization** | | | |
| Average % of Full Load (C): | _____ | % | |
| Operating Hours per Year (D): | _____ | | |
| **Cost of Compressed Air Production** | | | |
| Electrical Unit Cost (E): | _____ | $/kWh | 0.05 |
| Electrical Demand Cost (F) | _____ | $/kW | $13-15 |
| Total Annual Cost of Consumption (A x C x D x E x 0.746): | _____ | | |
| Total Annual Cost of Demand (A x C x F x 12 x 0.746): | _____ | | |
| Total Annual Cost: | _____ | | |
| Cost of Production: | _____ | $/1000 CFM | |
| **Cost Estimate of Leaks** | | | |
| % of Compressed Air Lost to Leaks: | _____ | | 10% - 20% |
| Annual Cost of Leaks: | _____ | | |

**OPPORTUNITIES**

| | |
|---|---|
| Reduce Air Leaks<br>Reference: 6.2.3 | Most industries that use compressed air have leakage rates in the range of 10 to 20%. A pinhole leak (1 mm) on a system with a working pressure of 600 kPa (gauge) costs approximately $10/month. A leak that is 5 mm in diameter on the same system costs approximately $298/month. A review of compressed air losses for an APMA member facility with a capacity of 2160 cfm, showed air losses were costing the firm in the range of $25,000 annually. |
| Automatic Shut Off<br>Reference: 6.2.3 | Each individual production machine should have only one source for the supply of compressed air. Each supply point should be provided with an automatic shutoff valve interlocked with the start/stop controls at each machine. |
| Operating Mode<br>Reference: 6.2.3 | In some cases switching the operating mode from the modulation control mode to the on/off control mode and installing receiver capacity can result in a corresponding reduction in energy consumption. At one auto parts facility the energy savings was estimated to be $9,300 annually. |
| Blow Off Nozzles<br>Reference: 6.2.3 | As an example, a ½" pipe at 90 psi, will consume approximately 375 SCFM of compressed air. Installing a high efficient plastic nozzle at a cost of $20.00 will reduce compressed air down to 117 SCFM (65%). The savings associated with this application, assuming the compressed air losses are occurring 24 hours/day 5 days/week would be equivalent to $12,400/year. |
| Install Control System<br>Reference: 6.2.3 | The installation of a control system can reduce energy usage by optimizing the compressed air system and identifying deficiencies in the system. Sarlin Balance through Goodfellows Consultants (905-858-4424) has a control system available for large users of compressed air and reports that its system typically reduces energy costs by 20-30%. |

## TABLE 7.5
## WATER REDUCTION OPPORTUNITIES WORKSHEET

| Plant Position | | Typical Valu |
|---|---|---|
| Water Purchase Cost (Including Sewer Charges): | | |
| Annual Consumption: | $m^3$ | |
| Unit Cost: | $/m^3$ | $1.00 - $1.5 |
| Annual Cost: | | |
| % of Total Water Used in Production: | | |
| % of Total Water Used for Sanitary Purposes: | | |
| Total: | 100% | |
| Annual Cost of Water for Production: | | |
| Annual Cost of Sanitary Water: | | |
| Wastewater Cost: | | |
| Annual Sewage Surcharge Cost: | | |
| Annual Cost of Wastewater Treatment: | | |
| Total Annual Cost: | | |

| OPPORTUNITIES | |
|---|---|
| Reduce Sanitary Water Use<br>Reference: 6.3.1 | Install or retrofit sanitary water fixtures such as toilets, urinals, showers and lavatory faucets. |
| Install Flowmeters<br>Reference: 6.3 | In order to improve accountability consideration should be given to installing flowmeters for key areas of consumption. |
| Conduct Regular Maintenance<br>Reference: 6.3 | In order to maintain operational efficiency and minimize leaks, regular maintenance required to identify and repair leaks as soon as possible. |
| Cooling Towers<br>Reference: 6.3.2 | Typically cooling towers account for a large percentage of the total water consumpt of any industry (approximately 20%). Make-up water is required to compensate for water losses through evaporation, drift and blow-down. Options are available to minimize blow-down while maintaining water quality. |
| Parts Cleaning<br>Reference 6.3.2 | Parts cleaning can also utilize large quantities of chemicals and water. Options available to reduce water consumption include conversion to high pressure wash systems, use of counter current rinse methods, alternative cleaning agents, replaci baths with spray rinses, and eliminating single-pass uses of water where possible. |

## TABLE 7.6
## WASTE REDUCTION OPPORTUNITIES WORKSHEET

| Plant Position | | | Typical Values |
|---|---|---|---|
| **Scrap/Rejects** | | | |
| | Cost of Haulage: _____ | $/year | |
| | Cost of Scrap: _____ | $/year | |
| | _____ | $/unit of production | |
| **Paper/Packaging** | | | |
| | Cost of Haulage: _____ | $/year | |
| | _____ | $/unit of production | |
| **Hazardous Waste** | | | |
| | Cost of Manifested Waste: _____ | $/year | |
| | _____ | $/unit of production | |
| **Waste Treatment Cost:** | | | |
| | Equipment: _____ | $/year | |
| | Labour: _____ | $/year | |
| | Chemicals: _____ | $/year | |
| | _____ | $/unit of production | |
| **Air Emissions** | | | |
| | Treatment Costs: _____ | $/year | |
| | _____ | $/unit of production | |
| | Total Waste Cost: _____ | $/year | |
| | _____ | $/unit of production | |

**OPPORTUNITIES**

| | |
|---|---|
| Reduce Scrap<br>Reference: 6.5.2.2 | Waste reduction and QS 9000 are closely tied together. A good quality program will encourage waste reduction. |
| Reduce Packaging<br>Reference: 6.5.2.3 | The best way to reduce the amount of packaging waste is to work with your suppliers to reduce the quantity of cardboard, pallets and drums entering your facility. Cardboard, wood pallets and paper should all be recycled where there use cannot be eliminated. |
| Reduce Hazardous Waste<br>Reference: 6.4.2, 6.4.3 | When selecting non-production materials, an emphasis should be placed on environmentally friendly products. Materials that use solvents, phenols, lead and other chemicals should be minimized. The use of alternate solvents should be investigated. |
| Reduce Air Emissions<br>Reference: 6.6 | Numerous measures are available to reduce air emissions from painting, solvent and other operations. These include alternate paint application technologies, reducing VOC content in paint, and the use of water wash systems. |

# 8.0 NEW TECHNOLOGIES, SOURCES AND DEVELOPMENT STATUS

## 8.1 PROGRAMS FOR THE ADVANCEMENT OF NEW ENVIRONMENTAL TECHNOLOGIES

There are several programs in place in Ontario, Canada and the United States to promote the development of new environmental technologies. The following provides a description of some of the prominent programs.

- ***Ontario Centre for Environmental Technology Advancement (OCETA)*** - the mission of the OCETA is "To foster the development and economic competitiveness of small and medium-sized Canadian firms through environmental technology advancement and commercialization by providing access to technical, business, regulatory, financial, educational and management services, and by providing key information and support services." OCETA has prepared over forty profiles on specific new technologies that Canadian firms are developing/marketing. These include technologies for soil/sediment remediation, groundwater remediation, water and wastewater treatment, liquid waste treatment, air pollution control, solid waste handling, instrumentation and monitoring, energy efficiency, recycling, habitant rehabilitation, and software/modelling.

- ***Environmental Technology Verification (ETV) Program*** - this is a recently announced (June 1997) initiative of Environment Canada and Industry Canada. It is a voluntary program designed to improve the marketability and credibility of Canada's environment industry by providing independent verification of performance claims.

- ***National Industrial Competitiveness through Energy, Environment, Economics (NICE$^3$)*** - this U.S. Department of Energy program is designed to promote energy efficiency, clean production and economic competitiveness in industry. Grants are available to American companies to support innovative technology development that can significantly conserve energy, reduce industrial wastes, prevent pollution and improve industrial cost competitiveness.

- ***Enviro-Access*** is one of the three Canadian Environmental Technology Advancement Centers (CETAC), whose responsibilities are distributed geographically. Enviro-Access serves Quebec and the Atlantic provinces. The other two centers are the OCETA and the Canadian Environmental

Technology Advancement Corporation - West (CETAC-West). Enviro-Access provide similar services to the OCETA which are described above.

- ***Rapid Commercialization Initiative (RCI)*** is a program of the U.S. Department of Commerce to encourage identification and mitigation of barriers to the commercialization of environmental technologies. RCI provides assistance in addressing three key barriers to commercialization; assistance in finding appropriate sites for demonstrating the technology; assistance in verifying the performance; and assistance in obtaining permits.

## 8.2 NEW ENVIRONMENTAL TECHNOLOGIES

The following is a summary of new environmental technologies that are applicable to the automotive parts sector.

### 8.2.1 Biofiltration of Exhaust Gases

Biofiltration can be used to treat volatile organic compounds (VOCs) and also reduce odours. Biofiltration involves passing exhaust gases through a filter of microorganisms in a bed of peat/compost. The contaminants in the exhaust gases are biodegraded by the microorganisms and converted to carbon dioxide and water. The advantages to biofiltration are that the process is environmentally friendly producing no byproducts (i.e. scrubber wastewater) and it has reasonably high removal efficiencies (90-99%) for VOCs. The disadvantages to biofiltration are the large amount of space required for the equipment and that this system can only treat exhaust gases that are less than 40°C.

### 8.2.2 Hygrex - Closed-Loop Drying Systems

As discussed earlier, HYGREX™ has on the market a new closed-loop drying system that operates on dehumidification principals as opposed to the more commonly used evaporative systems. Unlike heat based dryer systems, the HYGREX™ closed loop drying system does not require exhaust or air makeup, nor does it add heat to the material being dried or surroundings and the waste water removed is recovered for reuse. Although HYGREX™ is a relatively new technology, nine systems have been installed at Ford, four at Honda and three at Toyota. Advantages include low electrical requirements, lower space requirements, low temperature, and lower capital cost. This system is applicable for the removal of water from manufactured components including:

- water washed components drying;
- water based paints drying; and
- sludge drying.

The typical costs of using a conventional dry-off oven rated at 1 MMBTU/hr is $6/hr. In a similar 10 kW HYGREX™ unit the cost would be as low as $0.50/hr. Ford has reported that their energy costs are 1/6$^{th}$ of a conventional system.

### 8.2.3 Hydroforming

Hydroforming is a new manufacturing process that starts with a straight or bent, welded, round tube that is placed in a forming die. The tube is then filled with fluid at sufficient pressure to force the tube to conform to the shape of the die cavity. This emerging technology can produce tubing that is ideal for car sub-frames, structural parts such as engine cradles, radiator surround/support, lower and upper longitudinal body rails, instrument panel support beams, steering column energy absorption bellows, D-pillars for station wagons, and various body cross members.

The benefits to hydroforming over conventional stamping are reduced tooling costs, improved dimensional accuracy, less or negligible die wear, elimination of weld flanges, reduced weight, and increased strength and stiffness. Environmental benefits include reduced use of die lubricants and reduced energy costs.

### 8.2.4 Conserval Wall

The Conserval Wall using solar energy to preheat building make-up air. This simple product essentially consists of a sheet of black perforated metal placed about 30 cm away from a building wall. A fresh air supply fan pulls the outside air through the perforations, through the large plenum where the air is heated by solar radiation on the black south facing wall, and into the workplace. Thus the outside air is cheaply preheated saving money in energy costs and improving indoor air quality. Numerous installations are in place including the Ford Oakville plant. The advantages to the system are that there are no moving parts (other than the fan) and the operating costs are much lower than a conventional air-makeup unit. Due to the relatively high payback (4-6 years) there isn't a strong retrofit market. However, for new installations the cost is only marginally more than traditional construction.

### 8.2.5 Bioforj - Bioremediation of Waste Oils

Bioforj is developing a biologically active product, Enretech, that may be used to bioremediate oily wastes. Though this method has not yet been accepted as a method of disposing of PCB's in Ontario, testing has shown it is capable of reducing the level of PCBs in transformer oil from above 100 ppm to non-detectable limits. Bioforj also has licensed biological treatment technology available for the treatment of soils.

### 8.2.6 COMPLY 2000 - $NO_x$ Reduction

The COMPLY 2000 technology is an indirect contact heat exchange and scrubbing system, designed to remove combustion emissions such as nitrogen oxides ($NO_x$) from boiler flue gases. Testing conducted under the Environmental Technology Verification (ETV) Program supported the claim of a minimum removal efficiency of 90% for nitrogen oxides. This technology is now ready for industrial full-scale application in natural gas and oil-fired boilers.

# 9.0 VALIDATION OF RESOURCE CONSERVATION AND POLLUTION PREVENTION

## 9.1 EXAMPLES

A joint industry/government initiative is currently underway to develop and implement voluntary pollution prevention/toxic use reduction plans for the automotive parts manufacturing sector. The Automotive Parts Manufacturing Pollution Prevention Project is a voluntary co-operative effort amongst participating members of the APMA, Ontario MOE and the federal Department of Environment (DOE). As part of this project participating companies and the APMA have prepared a report which describes the pollution prevention and waste reduction efforts that have been undertaken. This progress report is available on the internet at http://www.cciw.ca/glimr/data/second-auto-part/intro.html. The following is a listing of some of the measures that have been implemented:

**Water Conservation** - Bundy of Canada decreased rinse water usage by 20% by implementing flow controls and improving process management.

**Elimination of Chlorinated Solvents** - Bundy of Canada eliminated the use of methyl chloroform solvent used to clean the date-stamping operation by working with the customer to eliminate the need for date-stamping. Dana Canada (Spicer Driveshaft) replaced methyl chloroform and subsequently terpene with a water based parts cleaner. Long Manufacturing eliminated the use of 1,1,1-trichlorethane by implementing the use of an alternate drawing compound that eliminated the need for subsequent degreasing.

**Elimination of Caustic Cleaning Solution** - Long Manufacturing replaced its caustic etch process with a mechanical cleaning process that uses brushes to remove the oxide layer from the aluminum strip. The waste caustic solution generated was reduced from 120,000 kg/yr to zero.

**Reduction in Alkaline Cleaner Usage** - Bundy of Canada reduced its usage of alkaline cleaner by 60% by installing ultrafiltration to increase the life of the alkaline cleaning bath.

**Elimination of Chromium in Conversion Coating Process** - Long Manufacturing eliminated the use of chromium by implementing an alternative conversion coating system.

**Reduction in Die Lubricant Usage and Waste** - Burlington Technologies reconfigured its centralized die lubricant system from trenches to overhead piping.

This change made maintenance easier and allows leaks to be quickly identified and repaired. As a result, purchases of die lubricant were decreased by 10%.

**Energy Conservation by Using Liquid Aluminum** - Burlington Technologies reduced its energy consumption by 50% by substituting aluminum ingots with liquid aluminum delivery.

**Compressed Air Pressure Reduction** - Burlington Technologies reduced its compressed air pressure to 90 psi (700 kPa) from 110 psi (840 kPa) resulting in a 25% savings in energy costs for compressed air production.

**Compressed Air Usage Reduction** - Woodbridge Foam in Woodbridge implemented a program to save electrical consumption be reducing compressed air usage. Modification to valves on the moulding machines reduced compressed air usage in foam production by 90%. The vacuum pumps were reprogrammed to shut down during employee breaktimes (3 hours/day) resulting in a savings of $10,000/year with minimal cost. A total of 352,000 kWh/yr of electricity was saved in these two projects.

**Use of Returnable Containers** - The Woodbridge Foam plant in Woodbridge worked with its suppliers to reduce the number of cardboard containers used and replace them with returnable plastic containers. Cardboard consumption dropped by over 95% saving approximately 470 tonnes of cardboard per year.

**Recycling of Metalworking Fluid** - Burlington Technologies has reduced their waste metalworking fluids by 90% and decreased their new fluid purchase by 50% by using an external contractor on-site for fluid recycling. After including the cost of the recycling, the current new fluid costs have been reduced by more than 30%. At Dana Canada, the same reductions resulted when an off-site contractor was used for recycling/recovery.

**Recycling of Hydraulic Fluid** - Burlington Technologies has reduced its waste hydraulic fluid by 90% by using an external contractor on-site for recycling.

**Recycling of Lubricating Oil** - Dana Canada (Spicer Driveshaft) implemented a recycling operation on-site with an independent contractor that reduced lubrication oil purchases by 75%.

**Foam Scrap Reduction** - The Woodbridge Foam plant in Woodbridge reduced their foam scrap production by 65% through improved process control, input chemical reformulation and procedural changes implemented by employees.

A similar project is currently underway with the Canadian Vehicle Manufacturing Association that has shown similar successes in pollution prevention implementation.

## 9.2 Case Histories from Canadian and Foreign Sources

Published case studies on resource conservation and pollution prevention are available from several sources. The following are some sources of information that demonstrate implementation of pollution prevention in Canada and other parts of the World.

**Green Industrial Analysis Program** - This program, sponsored by the Ontario Ministry of the Environment, was aimed at helping Ontario Companies to use energy and water more efficiently and to reduce or eliminate air emissions, liquid effluents and solid wastes. Green Industrial Analyses were conducted on over 40 facilities between 1994 and 1996. The facilities related to the automotive and automotive parts sector that participated in the program are as follows:

- Stelco Fasteners Ltd, Brantford (profile available)
- Monroe Auto Equipment Co. of Canada, Owen Sound (profile available)
- Goodyear Canada Inc., Collingwood (profile available)
- Richmond Die Casting Ltd., Cornwall
- Budd Canada Inc., Kitchener
- Waltec Plastics, Midland
- Fomoco Oakville Assembly plant, Oakville
- Freightliner Of Canada Ltd., St. Thomas (profile available)
- Cami Automotive, Ingersoll
- Spinic Manufactuirng Ltd., Guelph
- Canadian General-Tower, Cambridge

Project Profile for some of the projects (as noted above) are available from the Industry Conservation Branch of the Ministry of the Environment (416-327-1492). The Ministry is currently in the process of making the project profiles available on the MOE web site at "http://www.ene.gov.on.ca/envision/program/index.htm".

**The Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET)** - The CADDETT technical brochures describe proven energy saving technologies. Each brochure provides the aims and background of the project, a description of the technology and its application, plus a full breakdown of costs and savings. Over 200 hundred brochures are currently available for projects in Europe, Japan, Canada and the United States. In reviewing the list of brochures, other than projects on general energy savings, there are only a few applicable to the automotive parts sector. These include brochures on "Free Cooling in Plastics Plant" and "IR Oven for Vehicle Paint Stoving". Publications are available on the CADDET website at "http://caddet-ee/home.htm". The publications for this international program are also available locally through Natural Resources Canada (1-800-387-2000).

**Auto Industry Pollution Prevention Project** - This project is a partnership between the Michigan Department of Environmental Quality and Chrysler, Ford, and General Motors to focus pollution prevention efforts on persistent toxic substances that adversely affect the Great Lakes basin. Case studies of pollution prevention

initiatives by auto companies under the Auto Industry Pollution Prevention Project (Auto Project) is available on the Michigan Department of Environmental Quality website at "http://www.deq.state.mi.us/ead/p2sect/auto/". The following is a list of the case studies currently available.

- Chrysler
    - Lead-free black ceramic paint
    - Non-production material screening
    - Mercury reduction program
    - PCB elimination program
    - Surface coating toxics reduction program
    - Elimination of chromium from radiator paint
    - Consumer anti-freeze remanufacturing
    - Post consumer anti-freeze remanufacturing
    - Stamping plant toxic reductions
    - Pollution prevention projects with the neon
    - Chrysler honors environmental excellence recognition (cheer) program
    - Elimination of trichloroethane vapor degreasers
    - Mineral spirits elimination in machining plants
    - Plant sets 95% goal to reduce tri releases Dayton - Thermal Products Plant
    - Glycol ether reduction in surface preparation materials - Newark Assembly Plant
    - Implementing a supplier solvent management program reduces solvent and cleaner use & VOC emissions
    - Chrome-free phosphate post treatment
    - Kokomo Transmission plant reuses plastic
    - Lead-free electrocoat

- Ford
    - Recent pollution prevention projects
    - Handling of spent lead-acid batteries
    - Process change to eliminate the use of trichloroethylene
    - Toluene emissions minimized
    - Reducing the release of trichloroethylene and methylene chloride
    - Tetrachloroethylene
    - Solvent use reduction at the Ford Romeo Engine Plant
    - Waste prevention strategy implementation
    - Pollution prevention strategy
    - Basecoat and solvent reduction project
    - Molded fiberglass headliner offal reduction project
    - PCB transformer phase-out plan
    - Wastewater treatment process improvement
    - Chlorine use reduction at Michigan proving grounds
    - Wastewater treatment sludge reduction
- General Motors
    - Reducing freon use
    - Substitution with a solvent-free adhesive
    - Reformulation of PVC insulation
    - Recovering lead from wastewater
    - Solvent-free spray adhesives for interior trim
    - Rescheduling paint booth cleaning reduces solvent use & VOC emissions
    - Copper and nickel reclamation from plating waste

- Adjusting paint equipment reduces emissions, solid waste and saves money
- Columbus IFG plant eliminates methylene chloride
- Reducing chrome, VOC at the source
- Recycling chrome from rinsewater
- Removing lead and solvent from automotive electronics operations
- Reducing VOC emissions from purge solvent
- Reducing air emissions and solid waste from vehicle painting operations
- Reducing air emissions by conserving compressed air
- Reusing/recycling of steel anti-rotation pins
- Elimination of mercury switches in underhood and trunk lamps
- Recycled plastic in hush panels

**Pollution Prevention Research Projects Database** - this database provides the latest information on pollution prevention research activities in the United States. The database includes the most comprehensive and up-to-date information available from one source. It currently includes more than 300 projects, and will continue to grow as more research is conducted. The majority of the projects included in the database were conducted by state and federal agencies, universities and nonprofit research institutions. Other sources of information are from local government and private industry research. The website is located at "http://pprc.pnl.gov/pprc/rpd/rpd.html".

**Enviro$en$e** - Funded by the United States Environmental Protection Agency and the Strategic Environmental Research and Development Program, allows those implementing pollution prevention programs or developing research and development projects to benefit from the experience, progress, and knowledge of their peers. Enviro$en$e includes a pollution prevention forum for all levels of government, researchers, industry, and public interest groups. Search access is available to a number of environmental issue databases, including the Department of Defense P2 Technical Library, the Hazardous Solvent Substitution Data System, and the Environmentally Preferred Products Catalog. The website is located at "http://es.inel.gov".

**EPA WASTEWI$E Program** - is a voluntary US EPA partnership with businesses to reduce municipal solid waste. US EPA provides recognition to WasteWi$e companies by highlighting successful waste reduction efforts and provides technical assistance via a hotline, newsletter, peer exchange network, how to tip sheets, and

workshops." These documents are hosted by the ULS Report (Use Less Stuff) which is a bi-monthly consumer oriented publication from Partners for Environmental Progress. The website is located at "http://cygnus-group.com/ULS/waste/epa.html".

# 10.0 OTHER HELPFUL INFORMATION

The following section provides information that may be helpful to members of the automotive parts sector. The information includes a list of suppliers, associations and agencies, pollution prevention/environmental management guidance documents, references and a glossary of acronyms.

**The Green Industry Office** of the Ministry of the Environment assists Ontario-based companies offering products, services and technologies that prevent pollution, protect or clean up the environment. Staff in the Green Industry Office offer a wide range of services, such as providing up to date information on Ontario's environment sector and key market influences, business planning advice, and export market development activities.

If your company is seeking assistance in identifying environmental technologies or services to implement the approaches described in this guide, please contact the Green Industry Office (416-323-4597). Through our databases, directories and personal contacts we will make best efforts to identify companies who can meet your environmental needs.

## 10.1 ONTARIO SOURCES OF EQUIPMENT/SERVICE SUPPLIERS FOR IMPLEMENTATION

It should be emphasized that the listing of company names here does not constitute endorsement by the MOE. These names are provided for information purposes only and we apologize to those that are not included.

The Ontario Ministry of the Environment and Canadian Plastics Industry Association jointly developed a sector guide in this publication series entitled; "Guide to Resource Conservation and Cost Savings Opportunities in the Plastics Processing Sector". The guide offers a series of generic process descriptions and checklists of improvement opportunities specific to each of seven major plastic processes including; 1) profile extrusion, 2) thermoplastic injection moulding, 3) flat film or sheet extrusion, 4) blown film extrusion, 5) blow moulding, 6) compression moulding of thermoset plastics and 7) foam moulding.

| | |
|---|---|
| Energy Efficient Closed Loop Drying System | HYGREX Spehr Industries<br>680 Harkwick Dr., Unit 4<br>P.O. Box 346<br>Bolton, Ontario<br>L7E 5T3<br><br>Phone: 905-857-3331<br>Fax: 905-857-3330 |
| COMPLY 2000 - $NO_x$ Reduction For Boiler Flue Gas | Enviro-Energy Products Inc.<br>148 Colonade Road South<br>Nepean, Ontario<br>K2E 7R2<br><br>Phone: 613-723-2422<br>Fax: 613-723-9210 |
| Bioremediation of Oily Wastes | Bioforj<br>P.O. Box 156<br>400 Silvercreek Road<br>Guelph, Ontario<br>N1H 6J9<br><br>Phone: 519-767-9854<br>Fax: 519-836-1602 |
| Low $NO_x$ Boilers | Miura Boiler Co.<br>8 Copernicus Boulevard<br>Brantford, Ontario<br>N3P 1Y4 |

## 10.2 ASSOCIATIONS/AGENCIES

| | |
|---|---|
| American Automobile Manufacturers Association | 7430 Second Avenue, Suite 300<br>Detroit, Michigan<br>U.S.A. 48202<br><br>Phone: 313-872-4311<br>Fax: 313-872-5400<br><br>Web Page: www.aama.com |

| | |
|---|---|
| Automotive Parts & Accessories Association, Inc. | 4600 East-West Highway<br>Bethesda, Maryland<br>U.S.A. 20184<br><br>Phone: 301-654-6664<br>Fax: 301-654-3299<br><br>Web Page: www.apaa.org |
| Automotive Parts Manufacturers' Association | 195 The West Mall, Suite 516<br>Etobicoke, Ontario<br>M9C 5K1<br><br>Phone: 416-620-4220<br>Fax: 416-620-9730<br><br>Web Page: www.capma.com |
| Automotive Industries Association of Canada | 1272 Wellington Street<br>Ottawa, Ontario<br>K1Y 3A7<br><br>Phone: 613-728-5821<br>Fax: 613-728-6021 |
| Canadian Association of Energy Service Companies (CAESCO) | 48 Reese Drive<br>Markham, Ontario<br>L3P 6B9<br><br>Phone: 905-294-3366<br>Fax: 905-294-1560<br><br>Web Page: www.ardron.com/caesco |
| Canadian Centre for Pollution Prevention | 265 N. Front Street, Suite 112<br>Sarnia, Ontario<br>N7T 7X1<br><br>Phone: 1-800-667-9790<br>Fax: 519-337-3486<br><br>Web Page: c2p2.sarnia.com |

| | |
|---|---|
| Canadian Council of Ministers of the Environment | CCME Secretariat<br>326 Broadway, Suite 400<br>Winnipeg, Manitoba<br>R3C 0S5<br><br>Phone: 204-948-2090<br>Fax: 204-948-2125<br><br>Web Page: www.mbnet.mb.ca/ccme |
| Canadian Environment Industry Association - Ontario Chapter | 23 Lesmill Road, Suite 102<br>Don Mills, Ontario<br>M3B 3P6<br><br>Phone: 416-447-2456<br>Fax: 416-447-2858<br><br>Web Page: www.ceia.on.ca |
| Canadian Vehicle Manufacturers' Association | 1602-25 Adelaide St. E.<br>Toronto, Ontario<br>M5C 1Y7<br><br>Phone: 416-364-9333<br>Fax: 416-367-3221 |
| EnviroAccess | 855, rue Pepin<br>Bureau 310<br>Sherbrooke, Quebec<br>J1L 2P8<br><br>Phone: 819-823-2230<br>Fax: 819-823-6632<br><br>Web Page: www.enviroaccess.ca |
| Environment Canada | Numerous Addresses for various programs<br><br>Web Page: www.ec.gc.ca/envhome.html |

| | |
|---|---|
| Industry Canada - Automotive Branch | 235 Queen Street<br>Ottawa, Ontario<br><br>Phone: 613-954-8400<br>Fax: 613-952-8088<br><br>Web Page: strategis.ic.gc.ca/sc_indps/sectors/engdoc/auto_hpg.html |
| Motor and Equipment Manufacturers Association | P.O. Box 13966<br>10 Laboratory Drive<br>Research Triangle Park, NC<br>U.S.A. 27709 3966<br><br>Phone: 919-549-4800<br>Fax: 919-549-4824 |
| Natural Resources Canada<br>Energy Efficiency Branch | 580 Booth Street, 18th Floor<br>Ottawa, Ontario<br>K1A 0E4<br><br>Phone: 613-995-6839<br>Fax: 613-947-4142<br><br>Web Page: www.eeb-dee.nrcan.gc.ca |
| National Round Table on the Environment and the Economy | Canada Building<br>344 Slater Street, Suite 200<br>Ottawa, Ontario<br>K1R 7Y3<br><br>Phone: 613-992-7189<br>Fax: 613-992-7385<br><br>Web Page: www.nrtee-trnee.ca |
| Ontario Centre for Environment Technology Advancement | 63 Polson Street, 2nd Floor<br>Toronto, Ontario<br>M5A 1A4<br><br>Phone: 416-778-5264<br>Fax: 416-778-5624<br><br>Web Page: www.oceta.on.ca |

| | |
|---|---|
| Ontario Ministry of Economic Development<br>Trade and Tourism<br>Office of Automotive Manufacturing Sectors<br>Branch | 7th Floor, Hearst Block<br>900 Bay Street,<br>Toronto, Ontario<br>M7A 2E1<br><br>Phone: 416-325-6769<br>Fax: 416-325-6885 |
| Ontario Ministry of the Environment<br>Industry Conservation Branch | 2 St. Clair Avenue West, 14th Floor<br>Toronto, Ontario<br>M4V 1L5<br><br>Phone: 416-327-7721<br>Fax: 416-327-1261<br><br>e-mail: rosatian@ene.gov.on.ca |
| Ontario Ministry of the Environment<br>Pollution Prevention Office | 40 St. Clair Avenue West, 12th Floor<br>Toronto, Ontario<br>M4V 1M2<br><br>Phone: 416-314-3878<br>Fax: 416-314-7930 |
| **U.S. DEPARTMENT OF ENERGY - ENERGY EFFICIENCY AND RENEWABLE ENERGY CLEARINGHOUSE** | P.O. Box 3048<br>Merrifield, VA<br>USA<br>22116<br><br>Phone: 1-800-DOE-EREC<br>Fax: 1-703-893-0400<br><br>Web Page: www.eren.doe.gov/erec/factsheets/erec.html |

## 10.3 POLLUTION PREVENTION/ENVIRONMENTAL MANAGEMENT GUIDANCE DOCUMENTS

The following is a list of Pollution Prevention/Environmental Management Guidance Documents that may be helpful.

CIPEC, Energy Efficiency Planning and Management Guide. Canadian Industry Program for Energy Conservation, Natural Resources Canada.

Natural Resources Canada, CEMET Resources Catalogue. 1994. (Available from NRCan at (613) 995-6839).

Ontario Environment Business Directory, 1998 Edition. (Available from the Ministry of the Environment, Green Industry Office at (416) 323-4597 or by fax (416) 323-4436.

Ontario Ministry of the Environment, Guide for Applying for Approval of Industrial Sewage Works. 1994. (Available from MOE at (416) 440-3718).

Ontario Ministry of the Environment, Guide for Applying for Approval (Air). 1994. (Available from MOE at (416) 440-3718).

Ontario Ministry of the Environment, Directory of Ontario Green Industries. 1996. (Available from MOE at (416) 325-4000).

EPA Office of Compliance Sector Notebook Project, Profile of Motor Vehicle Assembly Industry. Office of Compliance, Office of Enforcement and Compliance Assurance, U.S. Environmental Protection Agency, Washington DC, 1995.

US EPA, Coatings Alternatives Guide. Research Triangle Institute, U.S. Environmental Protection Agency, Washington, DC, 1996.

US EPA, Solvents Alternatives Guide. Research Triangle Institute, U.S. Environmental Protection Agency, Washington, DC, 1996.

Ontario Metal Finishing Pollution Prevention Task Force, Metal Finishing Pollution Prevention Guide. Ontario, September 1995.

## 10.4 REFERENCES

Ortech International, Report on the Canadian Coatings Industry. Environment Canada, Ottawa, Ontario, 1993.

Fourth Progress Report from the Task Force of the Canadian Automotive Manufacturing Pollution Prevention Project - MVMA Project. Ontario, 1996.

Second Progress Report from the Task Force of the Automotive Parts Manufacturing Pollution Prevention Project - APMA Project. Ontario, 1996.

Statistics Canada, Transportation Equipment Industries, SIC 32, 1994. Statistics Canada Industry Division, Annual Survey of Manufactures Section, Ottawa, Ontario, 1996.

## 10.5 GLOSSARY OF ACRONYMS

| | |
|---|---|
| APMA | Automotive Parts Manufacturers' Association |
| ARET | Accelerated Reduction/Elimination of Toxic Substances |
| BMP | Best Management Practices |

| | |
|---|---|
| BOD | Biological Oxygen Demand |
| CCME | Canadian Council of Ministers of the Environment |
| CEM | Continuous Emissions Monitor (or Monitoring) |
| CEPA | Canadian Environmental Protection Act |
| CFCs | Chlorofluorocarbons |
| CIPEC | Canadian Industry Program for Energy Conservation |
| CO | Carbon Monoxide |
| COD | Chemical Oxygen Demand |
| DAF | Dissolved Air Flotation |
| DOE | Canadian Department of the Environment |
| EMS | Environmental Management Systems |
| EPA | Environmental Protection Agency |
| HVAC | Heating, Ventilation and Air-conditioning |
| HVLP | High Volume Low Pressure |
| ICB | Industry Conservation Branch of MOE |
| IESP | Industrial Energy Service Program |
| IEEI | Industrial Energy Efficiency Initiative |
| IRT | Industry Review Team |
| ISO | Industrial Standards Organization |
| JIT | Just-in-Time Manufacturing Concept |
| MEDTT | Ministry of Economic Development Trade and Tourism |
| MOE | Ministry of the Environment |
| MSDS | Material Safety Data Sheet |
| NAFTA | North American Free Trade Agreement |
| $NO_2$ | Nitrogen Dioxide |

| | |
|---|---|
| $NO_x$ | Nitrogen Oxides |
| NPRI | National Pollutant Release Inventory |
| NRCan | Natural Resources Canada |
| OECD | Organization for Economic Cooperation and Development |
| OEM | Original Equipment Manufacturers |
| P2 | Pollution Prevention |
| P4 | Pollution Prevention Pledge Program |
| PCB | Polychlorinated Biphenyl |
| PSL | Priority Substances List |
| SIC | Standard Industry Classification |
| $SO_x$ | Sulphur Oxides |
| TKN | Total Kjeldahl Nitrogen |
| TOC | Total Organic Carbon |
| TSS | Total Suspended Solids |
| TSP | Total Suspended Particulate (Air) |
| TSS | Total Suspended Solids (wastewater) |
| UNEP | United Nations Environment Program |
| VCR | Voluntary Challenge and Registry |
| VOC | Volatile Organic Compound |
| WTP | Wastewater Treatment Plant |